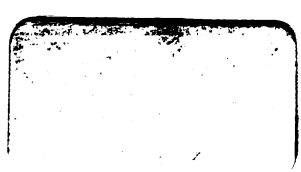

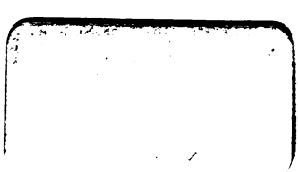

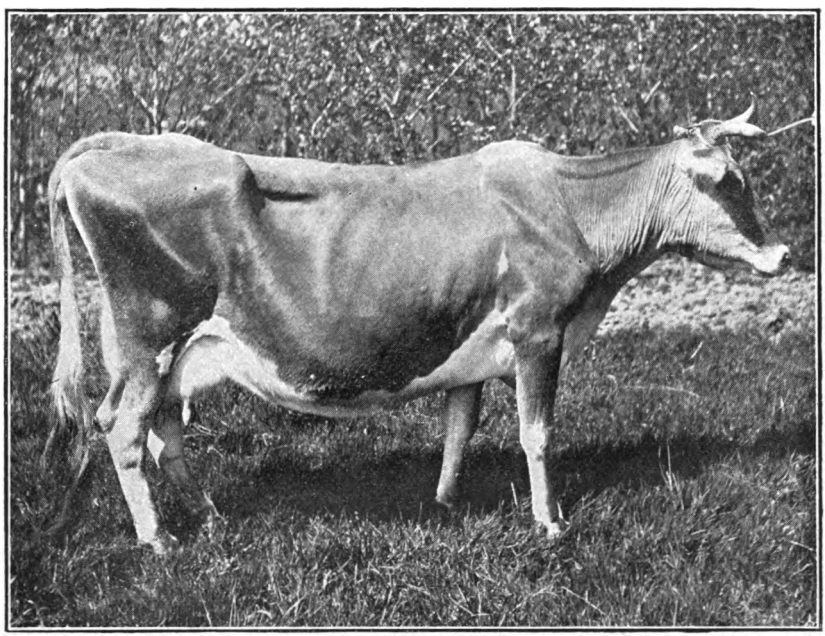

EVA, GRADE JERSEY, NINE YEARS OLD.

Average yearly butter yield for four consecutive years, 458 pounds. (See pages 327-342.)

UNIVERSITY OF VERMONT

AND STATE AGRICULTURAL COLLEGE

FIFTEENTH

ANNUAL REPORT

OF THE

VERMONT AGRICULTURAL

EXPERIMENT STATION

BURLINGTON, VT.

1901-1902.

BURLINGTON :
FREE PRESS ASSOCIATION,
PRINTERS, BINDERS, STATIONERS,
1902.

THE VERMONT

Agricultural Experiment Station,

BURLINGTON, VT.

BOARD OF CONTROL

PRES. M. H. BUCKHAM, *ex-officio*, Burlington.
HON. E. J. ORMSBEE, Brandon.
HON. CASSIUS PECK, Burlington.
HON. G. S. FASSETT, Enosburgh.

OFFICERS OF THE STATION

J. L. HILLS, Director.
G. H. PERKINS, Entomologist.
L. R. JONES, Botanist.
F. A. WAUGH, Horticulturist.
F. A. RICH, Veterinarian.
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W. J. MORSE, Assistant Botanist.
E. H. GREGG, Dairyman.
MARY A. BENSON, Stenographer.
E. H. POWELL, Treasurer.

ANNOUNCEMENT

The Vermont State Agricultural Experiment Station was established in accordance with an act of the General Assembly, approved November 24, 1886, for the purpose of promoting agriculture by scientific investigation and experiment. The station was established in connection with the University of Vermont and State Agricultural College, and for the past fifteen years has received the funds appropriated by congress under the provisions of the act commonly known as the "Hatch Act," approved March 2, 1887. The state appropriation expired in 1890. An appropriation "not to exceed $1000 annually" was made by the legislature of 1898 for the purpose of printing the annual report.

The station is prepared to analyze and test fertilizers, cattle foods, seeds, milk and other agricultural materials and products—exclusive of water and human foods which should be sent to the State board of health laboratory, Burlington—to indentify fruits, grasses, weeds, blights, etc., and insects, and to give information on various subjects of agricultural science for the use and advantage of the citizens of Vermont. The identification or analysis of minerals does not lie within the province of station activities. Such samples and inquiries should be sent to the State geologist, Burlington.

All chemical analyses, etc., proper to an Experiment station, that can be used for the public benefit, are made without charge, so far as time and means permit. The station will undertake no work the results of which are not at its disposal to use or publish, if deemed advisable for the public good. The results of such analyses will be promptly communicated to the party sending the sample. Those that are of general interest are published in the annual report or in the bulletins.

It is the wish of the Board of Control to make the station as widely useful as its resources will permit. Every Vermont citizen who is concerned in agriculture, whether farmer, manufacturer or dealer, has a right to apply to the station for any assistance that comes within its province to render, and the station will respond so far as it lies in its power. All communications, relating to agriculture, horticulture, plant or animal diseases, insects, etc., will be fairly considered, and, so far as possible, promptly answered.

The main station building is located on Main street at the south end of the college park. The farm and its buildings are on the Williston road, adjoining the university grounds on the east. Electric cars pass at Colchester Avenue and University Place, within a third of a mile of the station building. Both the station and the farm have telephone connections.

Instructions for taking samples of fertilizers, fodders, milk, seeds, etc., will be sent on application. Parties desiring to send samples should first write for these directions. Many samples received are useless, being incorrectly drawn. Parcels by express, to receive attention, should be prepaid and should bear the address of the shipper for purposes of identification.

Copies of the reports and bulletins of the station are sent free of charge to any address on application.

Address all communications, not to individual officers, but to the

EXPERIMENT STATION, BURLINGTON, VT.

TABLE OF CONTENTS

OF BULLETINS 88-95, PAGES 1-192, PUBLISHED DURING THE YEAR BUT NOT INCLUDED IN THIS VOLUME

* Compositor's error in pagination; pages 77-80 non-existent.

TABLE OF CONTENTS

OF FIFTEENTH ANNUAL REPORT

FINANCIAL REPORT FOR THE FISCAL YEAR ENDING JUNE 30, 1902

Vermont Agricultural Experiment Station, in account with the United States Appropriation, 1901-1902.

DR.

To receipts from the Treasurer of the United States as per appropriation for fiscal year ending June 30, 1902, as per act of Congress approved March 2, 1887..... $15,000 00

CR.

Abstract

By Salaries	1	$6,616 35	
" Labor	2	2,806 68	
" Publications	3	1,124 86	
" Postage and stationery	4	397 56	
" Freight and express	5	158 58	
" Heat, light and water	6	481 31	
" Chemical supplies	7	202 92	
" Seeds, plants and sundry supplies	8	131 91	
" Fertilizers	9	36 60	
" Feeding stuffs	10	1,252 71	
" Library	11	137 13	
" Tools, implements and machinery	12	34 68	
" Furniture and fixtures	13	132 41	
" Scientific apparatus	14	330 32	
" Live stock	15	27 00	
" Traveling expenses	16	312 53	
" Contingent expenses	17	66 45	
" Building and repairs	18	750 00	
			$15,000 00

We, the undersigned, duly appointed auditors of the corporation do hereby certify that we have examined the books and accounts of the Vermont Agricultural Experiment Station for the fiscal year ending June 30, 1902, that we have found the same well kept and classified as above, and that the receipts for the year from the treasurer of the United States are shown to have been $15,000, and the corresponding disbursements $15,000, for all of which proper vouchers are on file and have been by us examined and found correct.

And we further certify that the expenditures have been solely for the purposes set forth in the act of Congress approved March 2, 1887.

Signed,

{SEAL.}

MATTHEW H. BUCKHAM,
CASSIUS PECK,
GARDNER S. FASSETT,
} Auditors.

Attest, E. HENRY POWELL,
Custodian.

Receipts and disbursements under sections 4344-4359, Vermont statutes, (fertilizer law); No. 83 of the acts of 1898 (feeding stuffs law); No. 81 of the acts of 1898 (creamery inspection law); for the fiscal year ending June 30, 1902.

DR.

A.	To funds received for fertilizer control expense.....		$2,000 00
B.	To funds received July 1, 1901-June 30, 1902 from sale of inspection tags for feeding stuffs and forwarded to state treasurer ($1,133.70) plus balance last report ($212.39)		1,346 09
C.	To balance on hand last report	$13 07	
	To receipts from applicants for licenses.....	63 00	
	To receipts from supply houses, creameries and cheese factories for testing Babcock glassware	131 35	
			$207 42

CR.

	A	B	C
By Salaries	$590 00	$241 00	$.....
" Labor	150 58	121 59	153 75
" Publications	399 40	213 52	.....
" Postage and stationery	15 52	3 19	2 31
" Freight and express	15 54	51 28	1 90
" Heat, light and water	65 57	27 02	
" Chemical supplies	227 04	68 21	.....
" Sundry supplies	19 00	.....	27 60
" Furniture and fixtures	462 74		
" Traveling and sampling expenses		257 84	.....
" Contingent expenses		*193 65	†15 60
" Building and repairs	54 61		
Add amount forwarded to state treasurer against which no expenditures had been incurred prior to July 1, 1902		168 79	
Add balance on hand unexpended....			6 26
	$2,000 00	$1,346 09	$207 42

* Inspection tax tags. † Including $2.00 returned to applicants to whom licenses were refused.

REPORT OF THE DIRECTOR

J. L. HILLS

The present report covers the work of the station during the past fiscal year, July 1, 1901, to June 30, 1902. The bulletins issued during that time, Nos. 88 to 95 inclusive, as well as the annual report, are both indexed in the latter.

PUBLICATIONS

Eight bulletins and the 14th annual report, aggregating 424 pages of printed matter have been issued during the year in editions of 12,000 to 12,500. Bi-weekly newspaper bulletins have been published throughout the year. Abstracts of the regular bulletins appear on pages 205-208. A list of publications issued during the year follows:

1901.

October,	No. 88.	Analyses of commercial feeding stuffs, 16 pages.
November,	No. 89.	Plum culture, 12 pages.
December,	No. 90.	Apple growing in Addison county, 8 pages.

1902.

Fourteenth annual report, 234 pages.

February,	No. 91.	Analyses of commercial feeding stuffs, 16 pages.
April	No. 92.	Analyses of commercial fertilizers, 24 pages.
May	No. 93.	Commercial fertilizers, 54 pages.
May	No. 94.	Vermont grasses and clovers, 48 pages.
June	No. 95.	A poisonous plant—the common horsetail, 8 pages.

Many of the back bulletins and reports of the station are nearly or quite out of print. Parties having spare copies of any of the publications noted in the following list would confer a favor by returning the same to the station, thus enabling it to comply with requests from libraries and from other stations. Postage will be refunded to the sender on request.

All reports except the Third, Thirteenth and Fourteenth; Bulletins 1 *to* 11 *inclusive*, 15, 16, 19, 20, 22, 25, 28 *to* 34 *inclusive*, 36 *to* 40 *inclusive*, 42, 45, 50 *to* 52 *inclusive*, 56, 57, 59 *to* 63 *inclusive*, 65, 69 71 *to* 75 *inclusive.*

PUBLICATIONS ON HAND

The station has issued to the date of distributing this report, including the present number, 15 annual reports and 97 bulletins. Many of these are out of print. The following numbers are in print, and will be sent on request without charge as long as the supply lasts:

1888, April.	No. 12, Insecticides; seed tests; miscellaneous analyses	16 pages
November.	No. 13, Methods of cutting and planting potatoes; fertilizer analyses	12 pages
	No. 14, Analyses of fertilizers licensed for sale in the state of Vermont for the year 1888	16 pages
1889, October.	No. 17, Test of dairy cows at Vermont state fair	18 pages
	Third annual report	178 pages
1890, January.	No. 18, Pig feeding	20 pages
September.	No. 21, A new milk test; testing milk at creameries and cheese factories; notes for the laboratory	32 pages
1891, March.	No. 23, Analyses of fertilizers licensed for sale in the state of Vermont for the year 1891	16 pages
May.	No. 24, Potato blight and rot	16 pages
September.	No. 26, Maple sugar	24 pages
1892, January.	No. 27, Tests of dairy apparatus	12 pages
1893, May.	No. 35, Analyses of fertilizers licensed for sale in the state of Vermont for the year 1893	16 pages
1894, May.	No. 41, Analyses of commercial fertilizers	16 pages
November.	No. 43, Household pests	8 pages
December.	No. 44, Spraying orchards and potato fields	28 pages
1895, March	No. 46, Analyses of commercial fertilizers	16 pages
May.	No. 47, Commercial fertilizers	40 pages
October.	No. 48, Gluten feeds and meals	20 pages
December.	No. 49, Potato blights and fungicides	24 pages
1896, August.	No. 53, The pollination of plums	20 pages
November.	No. 54, Salad plants and plant salads	16 pages
December.	No. 55, Apple growing in Grand Isle county	16 pages
1897, April.	No. 58, Analyses of commercial fertilizers	16 pages
1898, April.	No. 64, Analyses of commercial fertilizers	16 pages
September.	No. 66, Club-root and black rot of the cabbage	16 pages
December.	No. 67, Hybrid plums	30 pages
1899, January.	No. 68, Inspection of milk tests and feeding stuffs	8 pages
April.	No. 70, Analyses of commercial fertilizers	16 pages
October.	No. 73, The trees of Vermont	54 pages
1900, March.	No. 76, The forest caterpillar	28 pages
April.	No. 77, Analyses of commercial fertilizers	24 pages
	No. 78, Analyses of commercial feeding stuffs	24 pages
	No. 79, Analyses of commercial fertilizers	12 pages
May.	No. 80, Analyses of commercial fertilizers	48 pages
September.	No. 81, Principles and practice of stock feeding	56 pages
	No. 82, Analyses of commercial feeding stuffs	26 pages
December.	No. 83, Apples of the Fameuse type	16 pages
1901, January.	No. 84, Analyses of commercial feeding stuffs	16 pages
	No. 85, Potato scab and its treatment	12 pages
March.	No. 86, Analyses of commercial fertilizers	24 pages
	Thirteenth annual report	258 pages
May.	No. 87, Analyses of commercial fertilizers	48 pages
October.	No. 88, Analyses of commercial feeding stuffs	16 pages
November.	No. 89, Plum culture	12 pages
December.	No. 90, Apple growing in Addison county	8 pages
1902.	Fourteenth annual report	234 pages

work, which, while unquestionably of much value to the farming interests, is held by the Secretary of Agriculture to be outside the province of the national enactment. Hence it is that the funds derived from the congressional grant cannot be used for such purposes and recourse must be had to other means of income.

THE CHEMISTRY AND PHYSIOLOGY OF MAPLE SAP FLOW

The station has been engaged in a study of this problem in a large way during the past five years, a force having been working in the sugar bush each season. A vast amount of data has been accumulated which has been but recently collated. It was hoped to include the consideration of this subject in this report but it has been found impossible to prepare it for publication in time to present it in this volume. It is expected to print the matter in bulletin form for distribution in the early spring. Two bulletins will be issued, one, a relatively elaborate one, giving a detailed discussion with data and another, a shorter and more popular presentation for general distribution.

WORK OF THE YEAR

Full statements of the main results of station endeavor during the past year published in this report (not in bulletins) in the departments of chemistry, botany, horticulture, and dairy husbandry are made under appropriate headings in the following pages.

Copies of the bulletins abstracted in the following pages will be sent without charge to any address on application.

ABSTRACTS OF BULLETINS

Bulletins 88 and 91: Analyses of Commercial Feeding Stuffs

By J. L. Hills, C. H. Jones and B. O. White

Three hundred and eighty-six samples of feeding stuffs collected in the spring and 476 samples gathered in the fall of 1901 have been analyzed.

No cases of adulteration were found among the cottonseed or gluten products, although some brands do not grade as high as others and are open to improvement. In many cases the guaranties of the manufacturers were not made good. This is particularly true of the Chicago, King, Waukegan and Davenport glutens and the germ oil meal. One linseed meal, the Mayflower brand, was found to be adulterated goods.

The oatmeal manufacturers' brands of oat feeds, corn and oat feeds, etc., were found, as usual, more or less loaded with oat hulls. Some of these brands are extremely inferior. One is called a ground oats, yet carries less than half the protein which oats should contain. Another is nothing more nor less than finely ground oat hulls, selling at twenty dollars a ton. Ninety percent of the provenders, (other than the output of the oatmeal mills) seem to be above reproach, while the remalning ten percent are hardly more than open to question. Two adulterated mixed (wheat) feeds were found. The wheat offals otherwise appear to have been of excellent grade and to carry exceptionally high protein contents.

It is thought that on the whole the grade of goods, particularly of provenders, is better than it was prior to the enactment of the law.—Pages 1-16, 37-52.

Bulletin 89: Plum Culture

By F. A. Waugh

There is a large opportunity for plum growing in Vermont, both in the production of fruit for market and in growing it for home use. Almost any soil in which water does not stand can be used for plums, providing those varieties are chosen which are suited to the particular soil and circumstances. Trees should be bought of a reliable nursery-

man; never from a tree agent. They may be set out either in fall or in spring, spring being recommended for persons who are not expert tree planters. Pruning follows somewhat the same method commonly used on apple trees. The ground should be thoroughly cultivated, especially on the surface, during early summer, but may be "laid by" about July 1st. The blossoms sometimes require cross-pollinating in order to set fruit. (This matter is more fully described in other publications of the station.) Black knot can be kept out by the timely use of the pruning knife. The rot of the fruit can be controlled by proper spraying and by thinning the plums. The curculio can be kept down by shaking the trees and catching the insects. Plums can be marketed most advantageously in small baskets when they are sold near home, or in the new-fashioned "six-basket carrier" when long shipments are necessary.—Pages 17-28.

Bulletin 90: Apple Growing in Addison County

BY F. A. WAUGH and M. B. CUMMINGS.

The apple growing business in the Champlain valley begins to enjoy an enviable reputation. Though less is heard of Addison county than of some other sections of the state, yet this section produces a greater quantity of apples than any other. The crop of 1900 was something over 30,000 barrels, and the crop of 1901 a trifle over a third as much, in Addison county. But while considerable quantities of fruit are grown the quality is not always what it should be, and the cultural methods are not so good as they might properly be. Improvement is suggested along the lines of cultivation, feeding the trees, spraying, pruning, better selection of varieties and better methods of marketing.—Pages 29-36.

Bulletins 92 and 93: Analyses of Commercial Fertilizers

BY J. L. HILLS, C. H. JONES and B. O. WHITE

The station has analyzed 136 brands, the output of eight companies, all drawn from dealers' stocks, all this year's goods.

Quantity of plant food furnished.—Nine-tenths of the brands were up to or above the guaranty and none failed to furnish the commercial equivalent of its promise.

Quality of plant food furnished.—While as a rule the quality of the crude stock used was good, there were some cases which seem open to criticism. Nearly a third of the brands carried no water-soluble nitrogen. There appears to have been somewhat inferior forms of

nitrogen used in some low grade goods and in the brands of two companies which in the past have trailed in the rear in this respect. The phosphoric acid was in some cases quite largely in the insoluble or reverted forms. Sulphate of potash is claimed to be present in five-sixths of the brands, but was actually found in but one-sixth.

Selling prices and valuations.—The average selling price approximated $28.23 and the average valuation, $20.18. One dollar in every three and a half paid for fertilizers met the costs of manufacture and sale. An amount of plant food which cost a dollar might have been bought at retail for cash at the seaboard for 64 cents in average low priced goods, for 71 cents in average medium grade brands, and for 75 cents in average high priced goods. In one-sixth of the brands, a dollar was charged for amounts of plant food which might have been bought at retail in the larger markets for 60 cents or less. "Cheap fertilizers" are usually the most expensive.

The average composition of the brands sold is somewhat higher than that of last year, and quite a little better than that of the two years previous to 1901. Selling prices have remained unchanged notwithstanding an advance in the price of crude stock. Plant food is as cheap as it ever was; yet buying mixed goods on time is still a more costly method of getting plant food than is home-mixing or buying on special order.

The comparison of analyses of brands for five years shows in some cases essential evenness and in others considerable variation in composition. The tables showing composition for five years should prove helpful to the early buyer of mixed goods.

Formulas for home mixtures are given and suggestions for their use made.—Pages 53-76, 81-136.

Bulletin 94: Vermont Grasses and Clovers

BY L. R. JONES

This bulletin contains an account of the general characters and agricultural value of the common grasses and clovers. It affords numerous illustrations aiming to make it possible for the careful observer to learn to distinguish these by characters of leaves, etc. The true grasses are distinguished from the worthless sedges and brakes on the one hand and the valuable clovers on the other. The following grasses are named and described as useful for hay and pasture purposes: timothy, orchard-grass, meadow-fescue, june-grass (Kentucky blue-grass), Canadian blue-grass, fowl meadow-grass, red-top, blue-joint, reed canary-grass, the manna-grasses. The following are described as

troublesome weeds: quack-grass, poverty-grass, foxtail-grasses, barnyard-grass, crab-grass. The clovers discussed are common red, mammoth, alsike, white, yellow hop clover, rabbit-foot clover; the clover allies, alfalfa, black medick, common vetch, bird vetch and the sweet clovers.

A general account of the methods of grass culture is followed by specific suggestions for seeding and mixtures for hay, pasture and lawn purposes. The impurities of grass and clover seeds are discussed. In the appendix is given a complete list of the grasses of the state, numbering about 140 species and varieties.—Pages 137-184.

Bulletin 95: A Poisonous Plant

BY F. A. RICH and L. R. JONES

Evidence has accumulated for some time that horses are seriously or even fatally poisoned by some plant contained in swale hay. The common horsetail (*Equisetum arvense*) is found to be the cause of the trouble. It is a plant which occurs everywhere in Vermont on moist sandy soils. Other common names it bears are foxtail, pine-top, jointed rush, etc. Observations by the veterinarian coupled with trial feedings show that even small quantities of equisetum in the hay cause sickness and death. The symptoms are unthriftiness, wasting of muscles, swaying and staggering gait, especially in the hind limbs, nervousness and muscular convulsions. The horse finally loses the ability to sustain itself on its feet and then soon dies. Young horses are more susceptible than older ones, while grain fed animals are more resistant. There is no evidence of poisoning from green plants in the pasture. Horses may acquire a depraved appetite for this weed so that they pick it out from the bedding.

Treatment consists in the removal of infested hay and administration of purgatives followed by the use of nux vomica.—Pages 185-192.

REPORT OF THE BOTANISTS

L. R. JONES and W. J. MORSE

In accordance with the plan of the later of the preceding reports of this department no attempt is here made to cover all the work of the year. Much of this is not sufficiently advanced to justify publication and on the other hand some of the results here published are based upon work antedating the current year. The subjects presented for consideration are as follows:

Potato diseases and their remedies.

I. Potato blights as they occurred in 1901 and 1902.
II. Results from spraying potatoes in 1901 and 1902.
III. Relation of date of digging to development of rot.
IV. The effect of top-pruning potatoes.
V. Potato scab experiments of 1901 and 1902.

Orchard diseases and their remedies.

I. Scabbing and russeting of apples in 1902.
II. Studies upon plum blight.

The cultivation of the locust-tree.

Killing weeds in lawns.

POTATO DISEASES AND THEIR REMEDIES

I. POTATO BLIGHTS AS THEY OCCURRED IN 1901 AND 1902

A discussion of the annual occurrence of potato blights has formed a part of the report of this department for a number of years. The lateness of the issuance of this volume enables us at this time to bring this statement fully up to date by including the discussion of the current year, 1902, in addition to that of the previous season, 1901.

The amount of damage in 1901 from leaf eating insects (Colorado and flea beetles), from arsenical poisoning, from the early blight fungus (*Alternaria Solani*) and from tip burn was about as on the average of preceding seasons and calls for no special comment. In 1902, owing to the remarkably cool and wet weather, the insects were much less destructive. There was also less than usual of the leaf-spotting by the early blight fungus. This fungus is evidently more prevalent on the warm dry soils and in warmer summers in Vermont. Tip-burn is always associated with hot dry weather and was of no practical consequence in 1902.

The feature of peculiar concern in both 1901 and 1902 was the prevalence of the late blight and rot due to the fungus *Phytophthora infestans*. This has been true of all northern New England and adjacent Canada. It is noteworthy as indicating that the destructive occurrence of this fungus goes, as it were, in waves, and that its extent, distribution and time of serious outbreak in one season is as clearly related to the disease conditions of the preceding season as to those of weather and of soil. The climatic and other conditions of 1900 were such that there was little evidence of the leaf blight; but some dry rot occurred in moist soils. Therefore there was only a moderate amount of the fungus in the fields in 1901 as carried over from the preceding year. The appearance of the blight on the leaves was first observed at Stowe about the tenth of August, when it was well established but not beyond control by prompt spraying. It was found at Burlington and other points in the Champlain valley during the next few days and by August 20 might have been found in the majority of the potato fields of the state. Fortunately the dryer weather of the latter half of August and of September prevented its continuous rapid spread. As a result the occurrence and progress of the leaf blight did not attract unusual attention, although the fungus was everywhere present, growing slowly but persistently on the leaves. The conditions were, therefore, ideal for a continuous showering of the soil with the spores and, consequently, for the infection of the tubers. The result was an unusual and, to many farmers, an unexpected amount of rot. On the unsprayed portion of the Experiment station plots this reached in some cases as high as 65 percent. This was on a ridge with a good surface drainage. Low fields where the soil was wetter came under our observation where fully 90 percent of the tubers showed rot at the time of digging. The extent of the loss from rot of the tubers in proportion to that of leaf blight due to this fungus was therefore greater than we have heretofore observed it. It is safe to state that there was more general infection of the seed-tubers planted in Vermont in 1902 than has occurred for some half dozen years. Such being the case, climatic conditions favorable to the fungus were sure to lead to a serious outbreak of the disease; and such conditions occurred.

In 1902 the weather was remarkably cool and moist up to about August first, and it has continued cool and with a more than usual amount of rainfall since. The first leaves showing the blight were collected July 13, which is nearly a month earlier than observed in 1901 and, indeed, is the earliest date recorded in our observations of a dozen years. From this date it spread insidiously in the fields of early potatoes under closest observation during the next two weeks so that by

August first it was widespread on the lower leaves although not as yet very conspicuous. In some other pieces of earlier potatoes on moister soil the foliage was badly blighted by the last week of July while on later planted ones on dryer soils the development did not begin until early in August. From this time on the spread was rapid and conspicuous. The vines of early potatoes went down during the first half of August and the later ones generally succumbed during the last half. Owing to the wet spring, planting was generally delayed until unusually late, most of it being done in June. Obviously the normal development of the crop required a healthy foliage well through September; but a canvass of the vicinity of Burlington on August 29 showed the plants in two-thirds of the fields entirely dead and in the balance rapidly dying. The weather following was less favorable to the blight and some of the plants lingered for a week or even longer but made no more healthy growth except where sprayed. Digging revealed a large amount of rot on the moister soils. The conditions are accordingly favorable for the destructive occurrence of the rot again in 1903 providing next summer be not an unusually dry one. The two practical steps to lessen the danger to the next crop are: First, the selection and saving of seed from the earlier planted crop on light dry soil, that there may be as little of the fungus as possible introduced with the seed potatoes; and, second, preparations beforehand for promptly and thoroughly spraying the plants with bordeaux mixture. As shown in the following article, this again proved a practical remedy for the leaf blight and reduced the amount of rot in both 1901 and 1902.

II. RESULTS FROM SPRAYING POTATOES

RESULTS FROM SPRAYING IN 1901

These experiments were carried out on three different plots as follows:

Plot I. Bug death compared with bordeaux-paris-green mixture.

Plot II. Spraying twice with bordeaux-paris-green mixture compared with spraying once.

Plot III. Spraying twice with bordeaux-paris-green mixture compared with using paris green alone.

Plots I and II were laid out in the main potato field of the Experiment farm. The soil was a medium clay loam upon which no potatoes had been grown for several years; variety, Delaware; planting done the last of May. Plot III was laid out in a potato field upon an adjacent farm, soil similar to plots I and II.

PLOT I. BUG DEATH.

July 20 the potatoes were treated as follows: row 1, bug death in water applied with a hand sprinkler at the rate of 25 pounds per acre; row 2, bug death applied dry with perfection sifter at the rate of 112 pounds per acre; rows 3, 4 and 5 sprayed with standard bordeaux-paris-green mixture (1½ pounds copper sulphate, 1 pound lime, 2 ounces paris green, 10 gallons water).

At the time of spraying there were a large number of young Colorado potato beetles upon the vines. The following day nearly all the beetles had disappeared from all the rows. August 23 the potatoes were treated as follows: row 1, bug death in water applied with hand sprinkler at the rate of 25 pounds per acre; row 2, bug death applied dry with perfection sifter at the rate of 62 pounds per acre; rows 3, 4 and 5 sprayed with standard bordeaux-paris-green mixture. This time the vines were again quickly cleared of the potato beetles. There was no noticeable difference in the appearance of any of the rows, those treated with bug death being as free from insect injuries, tip burn, etc., as those sprayed with bordeaux mixture. Two weeks later the rows treated with bug death were badly affected by late blight and somewhat by early blight, while those sprayed with bordeaux were blighted much less. Row 1, which had received the lighter application of bug death in water was blighted worse than row 2, on which it was applied more freely and dry. The blight continued to spread so that rows 1 and 2 were dead some time before 3, 4 and 5. The potatoes were dug October 8, at which time practically all the vines were dead. The results are given in the following table:

Row number	PLOT I. Treatment	Yields of potatoes of marketable size in bushels per acre			Percent rotten
		Sound	Rotten	Total	
1	Bug death in water	63.	131.	194.	67.
2	" " dry	66.	112.	178.	63.
3	Bordeaux-paris-green mixture	155.	81.	236.	34.
4	" " " "	157.	66.	223.	30.
5	" " " "	140.	67.	297.	32.

Discussion of results.—The conclusion reached was that bug death applied in such liberal amounts either dry or in water rids the plants of the Colorado beetles and lessens the injury from the flea beetles and other insects. The amount used, however, was in all cases exces-

sive, (on row 1 at the rate of 50 pounds per acre, on row 2 at the rate of 174 pounds) and so the test had no significance in deciding whether this powder is or is not an economical substitute for paris green or other arsenites. This was not the purpose of the experiment and the above conclusion was only reached incidentally. The primary object was to determine whether bug death has value as a *fungicide* in checking the blight and rot. The excessive amounts were used in order to give it the best possible opportunity to show such protection. The results were certainly conclusive on this point. Bug death even in excessive amounts, as here employed, (50 and 174 pounds per acre) *did not prevent the blight or rot.* Its inefficiency as a fungicide is evident by reference to the fact that the rot amounted to over 121 bushels per acre or almost two-thirds of the crop where this was used. It is claimed that it is a plant food. In view of this it is significant to compare the average total yield of rows 1 and 2, 186 bushels per acre, where the bug death was used, with the average of rows 3, 4 and 5, 252 bushels per acre, where bordeaux mixture was applied. Neither compound is a plant food in any ordinary sense and any gain from their use is attributable to the indirect benefits from protection against parasites. Neither of them has any more claim to the title of plant food than has paris green.

PLOT II. BORDEAUX-PARIS-GREEN MIXTURE

This plot gave an opportunity to compare the results from two applications of this compound with those from one application. On July 20 all the rows in the plot were sprayed alike with standard bordeaux-paris-green mixture. August 24 rows 1, 2, 3 and 7, 8, 9 were again sprayed, while rows 4, 5 and 6 were left unsprayed.

Two weeks later the rows sprayed once were nearly dead, while those sprayed twice were still green and growing. The difference was due chiefly to insect injuries and late blight. The blight continued to increase upon the vines sprayed once and they were entirely dead before the middle of September whereas the rows sprayed twice continued green well through this month and were not all dead October 8, when the last were dug.

The yields, expressed in bushels per acre, are shown in the following table:

PLOT II

Row number	Treatment	Large sound	Large rotten	Small	Total	Percent rotten
1	Sprayed twice, July 20, Aug. 24	190.8	16.5	17.2	224.5	8
2	" " " "	199.1	14.6	15.3	229.0	7
3	" " " "	140.0	26.7	14.9	181.6	16
4	Sprayed once, July 20,	32.9	101.0	7.5	141.4	75
4*	" " "	62.6	69.0	7.6	139.2	52
5	" " "	51.0	94.1	13.9	159.0	65
5*	" " "	66.1	73.0	20.4	159.5	52
6	" " "	56.2	75.0	10.6	141.8	57
6*	" " "	57.0	64.5	12.7	134.1	53
7	Sprayed twice, July 20, Aug. 24	163.2	3.5	13.9	180.6	2
7*	" " " "	159.2	13.0	8.5	180.7	8
8	" " " "	172.7	8.9	15.5	197.1	4
8*	" " " "	171.0	17.8	10.4	199.2	9
9	" " " "	175.6	7.0	12.1	194.7	3

Discussion of results.—The single application of bordeaux-paris-green-mixture protected the plants somewhat against insect attacks but was evidently of little avail against the late blight and rot which was at its worst a month later. It was the second application, made August 24th, which held this in check. The following statement of the average yields (large tubers) and of the amounts of rot will make this plainer.

	Sound.	Rotten.	Total	%rotten
Sprayed July 20 and Aug. 24 (rows 1-3, 7-9).	170.0	13.5	183.5	7
Sprayed July 20 (rows 4-6) ..	54.3	73.5	133.8	60

From this it is seen that about fifty bushels per acre was added to the total yield by prolonging the life of the vines as a result of the second spraying, and sixty-six bushels by checking the rot. A comparison with the gains from bordeaux-paris-green spraying in previous seasons is given later in this article.

PLOT III

This experiment was not carried on at the experiment farm which will account for some of the difficulties met with, and for the small yields.

The soil was a heavy clay loam. The variety of potatoes used was unknown. The crop was hoed only once and the field became overrun with weeds, mostly pigeon grass.

On July 30 rows 1, 2, 3, 7, 8 and 9 were sprayed with standard bordeaux-paris-green mixture, while rows 4, 5 and 6 were treated with paris green and lime applied with a hand sprinkler. At the same time

* Rows marked with a star (*) were dug Sept. 27, all others Oct. 8.

the owner sprayed the rest of the field with bordeaux mixture; but so small an amount was used as to produce little effect.

On August 19 all the rows were treated the same as before, except that a heavier application of bordeaux was used. At that time the rows sprayed by the owner were nearly all dead from tip burn, insects and early blight.. Those treated with paris green were likewise dying or dead from the same causes, while those sprayed with bordeaux mixture by the station were green and growing.

Three weeks later all the vines were dead, except those sprayed by the station, (1, 2, 3, 7, 8 and 9). These continued green until September 30, at which time all were practically dead. At this date they were dug. Very little rot was found, there being only nine rotten tubers in row 4, seven in row 5, and four in row 6. These were all found in a few adjacent hills. Unfortunately no record was made of those sprayed by the owner. The table shows the results of those treated with standard bordeaux-paris-green and those treated with paris green and lime.

Row. number.	Treatment.	Yield in bushels per acre.	
		Large tubers.	Small tubers.
1	Two applications bordeaux,paris-green mixture,	80.7	13.8
3	Two applications bordeaux-paris-green mixture,	95.5	15.9
3	Two applications bordeaux-paris-green mixture.	110.2	18.0
4	Paris green	69.0	24.4
5	Paris green	64.8	20.2
6	Paris green	57.3	19.1
7	Two applications bordeaux-paris-green mixture,	104.0	24.4
8	Two applications bordeaux-paris-green mixture,	112.5	32.9
9	Two applications bordeaux-paris-green mixture,	116.8	38.2

Average yield, large tubers, where bordeaux-paris-green was used..127 bu.
Average yield, large tubers, where paris green alone was used.....84 bu.
Gain, 43 bushels per acre or 51 percent.

Discussion of results.—This trial has little significance beyond further demonstrating that the proper use of bordeaux mixture on potatoes is a very profitable operation. In many cases, however, the work is only half done as it was by the owner of the potatoes in this field. It is then of little value.

RESULTS FROM SPRAYING POTATOES IN 1902.

It did not seem advisable to make comparative tests of fungicides this year. We have hitherto shown the superiority of the freshly prepared bordeaux mixture over all others and have at the same time showed that ready made bordeaux mixtures have distinct value. The

only purpose in spraying the tops experimentally the present summer was to keep up the serial records as to the gain from the use of bordeaux mixture. The opportunity for this was presented in the main potato field at the Experiment farm. The potatoes were Delaware planted about May 15, on a moist sandy loam. The sprayings were made August 1 and 20, using the standard bordeaux mixture (1½ pounds sulphate, 1 pound lime, 10 gallons of water). The potatoes were dug October 10 and the sorting done at this date. The character of the soil was not as uniform as desirable, so that more confidence is to be placed in the final averages than in the detailed comparisons, row by row. The details are, however, given in the following table, there being three rows in each plot, except III, where there was but one row, and VI, where there were four rows. The figures represent pounds per row.

			Total yields by rows		Average yield of plots		
Plot	Treatment	Row	Sound	Rotten	Sound	Rotten	Total
I	Not sprayed	1	45.	3.5	39.2	8.6	47.8
		2	34 5	8.			
		3	38.	14.5			
II	Sprayed twice	4	73.5	9 5	60.5	8.5	69.0
		5	44.	7.			
		6	64.	9.			
III	Not sprayed	7	50.	13.	50.	13.	63.
IV	Sprayed twice	8	74.	10.	69.2	11.2	80.4
		9	64.	15.5			
		10	69 5	8.			
V	Not sprayed	11	35.	13.	36.3	9.3	45.6
		12	34.	7.			
		13	40.	8.			
VI	Sprayed twice	14	70.	13.5	72.	12.1	84.1
		15	74.	10.			
		16	79.	12.			
		17	65.	13.			
VII	Not sprayed	18	33.	2.5	31.6	3.8	35.4
		19	23.	4.5			
		20	39.	4.5			
VIII	Sprayed three times	21	72.	4.5	70.6	2.6	73.2
		22	67.	0.5			
		23	73.	3.0			

The final averages per row including all of above data are:

Not sprayed .....Sound 37.2; rotten 7.8, total 45. percent rotten 17.4
Sprayed twice .....Sound 67.7; rotten 10.7, total 78.4, percent rotten 13.7
Sprayed three times...Sound 70.6; rotten 2.6, total 73.2, percent rotten 3.6

The rows were three feet apart and fifty-five feet long so that each row represents 1-264 of an acre. The yields of sound potatoes per acre as shown in the above experiment are, where not sprayed, 164 bushels per acre, where sprayed twice, 298 bushels per acre, where sprayed three times, 311 bushels per acre. The gain was, therefore,

134 bushels where sprayed twice, and 147 bushels where sprayed three times.

Discussion of Results.—Little is to be added to what has been stated heretofore. Bordeaux mixture again proved a reliable remedy in a trying season. The twice sprayed rows appeared almost as green as those sprayed three times. More rot occurred in these twice sprayed rows than the condition of the tops led us to expect. The loss was probably in part due to the fact that the two earlier sprayings were made by unskilled farm laborers who gave less attention than our trained assistants usually have to spraying the lower leaves. The fungus therefore had an opportunity to develop sufficiently on these to cause considerable rot, except where the third and more careful spraying was made on plot VII. On the face of the above returns there would seem to be a considerable profit from the third application. As a matter of fact we believe that if the second had been made as thoroughly on the lower leaves as was the third it would have sufficed to prevent the rot that occurred. For these reasons and because the figures for the two sprayings represent more reliable averages than for the three and are more directly comparable with the unsprayed plots we have chosen them for insertions in the table below. This table gives in summarized form some of the results obtained during twelve years past which in our judgment are fairly representative.

GAINS FROM USE OF BORDEAUX MIXTURE ON LATE POTATOES.

Variety	Planted	Sprayed	Yield per acre		Gain per acre
			Where sprayed	Where not sprayed	
White Star..	May 11, 1891..	Aug. 26, Sept. 8.....	313 bu.	248 bu.	65 bu.
" " ..	May 20, 1892..	July 30, Aug. 13, 25....	291 bu.	99 bu.	192 bu.
" " ..	May 20, 1893..	Aug. 1, 16, 29.....	328 bu.	114 bu.	224 bu.
" " ..	Apr. 26, 1894..	June 16, July 17, Aug. 30	328 bu.	251 bu.	72 bu.
" " ..	May 20, 1895..	July 25, Aug. 13, 31...	389 bu.	219 bu.	170 bu.
Polaris.....	May 15, 1896..	Aug. 7, 21.....	325 bu.	257 bu.	68 bu.
"	June 1, 1897..	July 27, Aug. 17, 28.	151 bu.	80 bu.	71 bu.
White Star..	May 10, 1898..	July 21, Aug. 10.....	238 bu.	112 bu.	126 bu.
Average 3 yrs	May 18, 1899..	July 26, Aug. 17, Sept. 8	229 bu.	161 bu.	68 bu.
Delaware....	May 23, 1900..	Aug. 4, 23.....	285 bu.	225 bu.	60 bu.
"	May 25, 1901..	July 20, Aug. 21.....	170 bu.	54 bu.	68 bu.
"	May 15, 1902..	Aug. 1, 20.....	298 bu.	164 bu.	134 bu.
Averages for twelve years.....			280 bu.	165 bu.	115 bu.

RESULTS FROM SPRAYING THE SOIL.

There are various causes for the rotting of potatoes. The common one in Vermont is the invasion of the tuber by the same fungus (*Phytophthora*) which causes the late blight or "rust" of the leaves. The popular idea of those who have observed this association of the blight and the rot is that the fungus causing the disease passes down the stem, but De Bary advocated some forty years ago that the decay of the tuber results chiefly if not wholly from the spores which fall from the leaves to the soil, and this explanation has been accepted by the later botanists generally.

While carrying on our spraying experiments this summer it occurred to us to try the effect of spraying the soil underneath the plants in certain unsprayed rows where the blight was developing. It seemed probable that if the rot of the tubers results from spores falling upon the soil, such spraying would reduce the amount. Accordingly early in August nine rows were set apart for this trial. The soil was a gravelly loam, fairly well drained, variety Delaware, planted May 15. The plants had not been sprayed up to this time, and there was a sprinkling of blight evident on the foliage of many of them, and as the results show the spraying was delayed too late for the full protection of any of the plants.

They were divided into three plots of three rows each which were treated as follows:

Plot I. August 13, the branches of the plants were raised and the spray directed underneath so as to wet the surface of the soil while avoiding the foliage as far as possible.

Plot II. Not sprayed in any way.

Plot IIII. Sprayed the tops as usual with bordeaux mixture on August 13 and on September 6.

As a result the blight was checked on plot III where the foliage was sprayed whereas it continued to develop in plot I where the ground alone was sprayed. By the first of September the foliage of the Plots I and II was practically all dead whereas that on plot III continued alive well through that month. When dug the second week of October the yields were as follows in pounds per row:

PLOT I. GROUND SPRAYED

Row	Sound	Rotten
1	45	0
2	60	1
3	46	1.5
Total,	151	2.5

PLOT II. NOT SPRAYED

Row	Sound	Rotten
4	45	3.5
5	35	8
6	38	14.5
Total,	113	26.

PLOT III. VINES SPRAYED

Row	Sound	Rotten
7	74	9.5
8	44	7.
9	64	9.
Total,	182	25.5

The gradual increase of rot progressing from rows 1 to 6 coupled with the irregularities in yield indicates that there was an unforeseen variation in soil conditions which favored the rot more on one side than on the other of the piece. The above results are not to be interpreted as final therefore; but, so far as they show anything, it is that spraying the surface of the soil greatly reduced the amount of rot. This result is in harmony with the idea that the tuber infection results from spores passing through the soil and which may be destroyed by such spraying. This method of spraying is not advocated as a practical remedy.

III. RELATION OF DATE OF DIGGING TO DEVELOPMENT OF ROT

How soon after the tops begin to blight should the potatoes be dug? This question has been asked so frequently that it was planned to secure some evidence regarding the matter this season. The following which appeared in a leading agricultural paper[1] some weeks after the work was begun shows that the investigation was timely: "Whether or not farmers shall dig their potatoes early to prevent rot is a question on which the search light of science has not been sufficiently turned. The best potato growers are divided in their opinion in the matter and experiment station workers are able to give but little advise based upon actual research."

To obtain some facts bearing upon this question experimentally, diggings have been made in a number of fields at different dates and the amount of rot noted at such times as well as that which subsequently developed. Fields which had not been sprayed were plainly desirable for such an investigation and also such as represented various conditions of soil and of disease. Since all of the plants on the Experiment farm had been sprayed permission was secured from a number of

[1] N. E. Homestead, Sept. 27, 1902, p. 291.

farmers in South Burlington to use portions of their fields for the trial diggings.

On August 23rd rows two and one-half rods long were staked off on the several farms, a part of which were to be dug on each of the following dates: August 25th, September 6th, 18th, and 30th. Following is a description of the plots, the condition of the tops on August 23rd, and each subsequent date till the tops were entirely dead.

Dewell's: Soil, sandy loam, neither very dry or moist. Ten rows, variety Enormous. Stalks and about ten percent of leaves green. Tops all dead on September 6th.

Wilson's (South Plot): Soil, clay loam. Six rows, variety Beauty of Beauties. Planted about June 1st. Showed blight on all hills, but leaves here and there only, so that field still looked green. September 6th, leaves all dead but stalks green. September 18th, tops entirely dead.

Wilson's (North Plot): Soil, like south plot, but somewhat more sandy. Nine rows. (Row three was not complete and was left out of the experiment.) Variety unknown. Planted last of May. Leaves dead with blight but stalks still green. September 6th, tops entirely dead.

Bixby's: Soil, sandy, well drained. Slopes south. Eight rows in pasture. Early variety, name unknown. Planted about May 1st. September 6th, tops entirely dead.

Holt's (South Plot): Soil, moist clay loam. Four rows, Beauty of Hebron, planted last of May. Early stages of blight, looked green but plenty of spots were found on the leaves. September 6th, leaves dead but stalks still green. September 18th, tops entirely dead.

Holt's (North Plot): Soil, very heavy clay loam, slopes to south. Eight rows, variety unknown. Planted early in June. Looked fairly green, but examination showed some blight scattered through. September 6th, considerably blighted, 25-50 percent of leaves green. September 18th, tops all dead.

With the exception of the rows dug on August 25th, the potatoes were allowed to stand over night in bags and then were poured into bushel boxes which were stacked up so as to allow free ventilation and kept in a cellar at a temperature of about 60° F. Every twelve days they were carefully sorted and all decayed tubers removed. Those dug August 25th remained in bags for the first twelve days at a temperature of from 65° to 70° F., considerably warmer than the average cellar. This may account for the relatively large percent of decay in this lot. On September 6th, they were placed in boxes and treated the same as the others.

The following tables give the total weights of each row when dug, the amount of decay at each sorting, the total decay, and the final weight of sound tubers on September 30th.

	Date of digging	Total weight	Pounds decayed Aug. 25	Pounds decayed Sept. 6	Pounds decayed Sept. 18	Pounds decayed Sept. 30	Average per row decayed to Sept. 30	Average per row sound on Sept. 30
Dewell's								
Row 1	Aug. 25	16.5	0	0	0	0.9	2.	14.7
" 5	" 25	16.9	0	.3	1.2	1.6		
" 2	Sept. 6	14	..	0	0	0	0.8	13.
" 6	" 6	13.6	..	.8	0	.8		
" 3	" 18	20.6	..	..	0	.4	0.4	15.8
" 7	" 18	15	..		0	.7		
" 8	" 18	13	..	..	0	0		
" 4	" 30	17.8	..	..	..	0	0.5	16.6
" 9	" 30	17.9	..	..	..	.4		
10	" 30	15.5	..	..	..	1.		
Wilson's (South Plot)								
Row 3	Aug. 25	8	0	4.4	.4	.2	5.	3.
" 4	Sept. 6	12.4	..	.8	.8	.7	2.3	10.1
" 2	" 18	11	..	..	.5	1.4	1.4	11.4
" 5	" 18	14.5	..	..	.5	.4		
" 1	" 30	13.5	..	..	..	.5	0.6	11.8
" 6	" 30	11.1	..	..	.	.6		
Wilson's (North Plot)								
Row 1	Aug. 25	39.3	0	11.7	13.3	.7	18.7	21.2
" 5	" 25	40.5	0	2.3	6.4	3.		
" 2	Sept. 6	29	..	1.4	.3	5.	4.3	26.2
" 6	" 6	32	..	.3	0	5.		
" 4	" 18	30.5	..	..	1 5	.3	1.2	34.3
" 7	" 18	40.5	..	..	.5	.1		
" 8	" 30	40.2	..	..	..	.5	0.9	34.4
" 9	" 30	30.2	..	..	..	1.2		
Bixby's								
Row 1	Aug. 25	54	0	.7	6.3	2.3	5.3	45.3
" 5	" 25	47	0	0	.5	.7		
" 2	Sept. 6	55.3	..	.5	.8	2.3	2.7	45.1
" 6	" 6	40.3	..	.2	.1	1.5		
" 3	" 18	48.4	..	..	..	..	0.	46.1
" 7	" 18	43.7	..	..	..	..		
" 4	" 30	46.5	..	..	..	..	0.	44.5
" 8	" 30	42.5	..	..	..	..		
Holt's (South Plot)								
Row 2	Aug. 25	19.3	..	7.2	3.3	1.9	12.4	6.9
" 3	Sept. 6	15.4	..	3.8	1.8	4.1	9.7	5.7
" 1	" 18	26.5	..	..	3.	1.4	4.4	22.1
" 4	" 30	15	..	..	..	4.5	4.5	10.5
Holt's (North Plot)								
Row 1	Aug. 25	25.1	0	5.1	6.	1.9	16.7	5.8
" 5	" 25	24.8	0	10.5	9.	0.8		
" 2	Sept. 6	23.1	..	7.2	0.9	4.	12.7	12.3
" 6	" 6	26.9	..	8.3	0.2	4.8		
" 3	" 18	24.6	..	..	6.6	3.5	9.3	14.5
" 7	" 18	23.0	..	..	5.5	3.		
" 4	" 30	19.7	..	..	..	5.2	7.4	17.3
" 8	" 30	29.5	..	..	..	9.5		

The following averages drawn from the above table will aid in the comprehension of the results:

Average total weight obtained per row at each date of digging:

When dug	Aug. 25.	Sept. 6.	Sept. 18.	Sept. 30.
Weight, pounds	28.6	26.2	25.9	24.9

Average weight of potatoes from each digging which were sound on September 30th:

When dug	Aug. 25.	Sept. 6.	Sept. 18.	Sept. 30.
Weight, pounds	18.7	20.9	23.5	23.0

Average decay per row on and previous to September 30th:

When dug	Aug. 25.	Sept. 6.	Sept. 18.	Sept. 30.
Pounds decayed	10.0	5.3	2.4	1.9
Percent decayed	35	20	9	8

Discussion of the results.—The size of the plots and the extent of the experiment are too limited to permit of sweeping generalizations. The temperature of the storage cellar was warmer than desired during the first two weeks and the results might have been different had it been cooler throughout the period. The results show wide variation on different soils and this suggests that on still other plots and in other seasons new combinations of conditions might occur to make the outcome different. Nevertheless it is clear that in no case did the amount of rot where the potatoes were left in the soil until the later date average greater than that where they were dug earlier; in some cases it was much less. These figures as they stand are liable to lead to an overestimate of the gain, however, since the actual amount of rot in the later dug plots is not clearly shown. When the potatoes were dug on the two later dates there were evidences that some tubers had almost or quite completely disappeared because of the rapid progress of the rot, and in many cases the partially rotten potatoes as sorted out at these later diggings had already lost much of their original weight. This fact accounts for the progressive falling off shown above in the average weight per row at each date of digging. It is clear, therefore, that the figures given under the last heading above, "average decay per row on and previous to September 30th," are too low for all except the first date. It would be more nearly correct to assume that the average weight of August 25th is the correct one to use as a starting point for each subsequent date and that the difference between that and the total weight actually found represents the weight of the tubers entirely lost by decay. Calculating in this way we secure the following:

Average decay per row on and previous to September 30th (computed).

	Aug. 25.	Sept. 6.	Sept. 18.	Sept. 30.
Pounds	10.0	7.7	5.1	5.6
Percent	35	27	18	19

The figures of greater practical interest and which are most easily understood, however, are those which show the returns of sound potatoes on September 30th. The same general conclusion is reached, whichever set of figures is taken, namely, that there was a greater loss on the average from the earlier digging.

Looking into the details more closely, however, it is seen that this was not equally great in all cases. Dewel's and Bixby's potatoes were grown on the lightest soil and died first. These show no noteworthy differences in rot, whether in cellar or field, after September. Wilson's potatoes grew on a somewhat heavier soil, the plants lived a little longer and the leaf blight was more in evidence. There this state of equilibrium was not reached until after the middle of September. At Holt's, where the soil was heavy, the plants lived longer and the leaf blight was worst, and it was apparently advantageous to delay the digging until the last of September. As nearly as we can formulate a rule based upon these results, it is that *where there is danger of rot it is best to delay the digging some ten days or more after the tops die and that a longer delay does no harm.* As stated before the experience of other seasons and on other soils is needed for safe generalizations.

If this is so, why is it? The question is pertinent but the attempt at a final answer may also well await further trials. The suggestion is made, however, that the rapidity of the invasion of the tubers by the fungus which causes the decay is accelerated as a result of the earlier digging either by the rise of temperature in the storage room or by some alteration in the physiological processes within the tuber. It may be conjectured that in the majority of cases where the tubers remain undisturbed in the soil the rapid invasion by the fungus ceases before it causes the death of the tissues of the potato tuber and that the fungus thereafter remains in a semi-dormant condition through the winter. Such a conjecture seems the more probable since a rapid decay of the tuber is doubtless destructive to the fungus as well as to the potato and so is disadvantageous to the former.

IV. THE EFFECT OF TOP PRUNING POTATOES

The moist cool weather of July and early August, 1902, led to unusual luxuriance in the development of potato tops especially where they had been properly sprayed. This condition brought to the Experiment station inquiries as to whether it was not desirable to check this tendency to vegetative vigor in some way as, for example, by breaking down the plants with a roller or by cutting them back. We have always advised against any such practice on theoretical grounds

but decided to put it to test this year since an especially favorable opportunity was presented through the courtesy of a local gardener, Mr. George W. Gero. His potatoes were the Green Mountain variety, planted May 19th on a rich sandy loam. They were well cared for, sprayed with bordeaux mixture July 23d and August 5th, and at the latter date showed an almost perfect stand of plants, completely covering the ground. Some neighbors of longer experience advised Mr. Gero to cut the vines back, else, it was said, "they would all run to tops" and he would lose much of his possible yield. He came to the station for advice and, while we discouraged him from mutilating his plants otherwise, we arranged to cut back the tops experimentally in a portion of the field. This was done on August 12th. The stalks were then about three feet long when straightened out and arose about two feet above the soil. They were cut clean at a height of one foot above the soil, which removed the bulk of the foliage. These stalks sent out within a few days many new shoots but this new growth began to yellow in about a week and the plants were dead by September first. In striking contrast the unclipped plants on either side were in full and vigorous foliage at this date and continued green through September; indeed there were some green plants when they were dug the second week in October. Seven rows, each one hundred feet long and three and one-half feet apart, were handled experimentally, five unclipped and two clipped. The yields were as follows:

Row 1, not clipped, yield 228 pounds.
Row 2, not clipped, yield 221 pounds.
Row 3, clipped, yield 150 pounds.
Row 4, not clipped, yield 223 pounds.
Row 5, not clipped, yield 224 pounds.
Row 6, clipped, yield 155 pounds.
Row 7, not clipped, yield 211 pounds.

Averages.—Not clipped, 221 pounds; clipped, 152 pounds.

It is evident that practically one-third of the crop was sacrificed by the clipping. This represents the result of but one trial and one method, but we believe that any other method which destroys or weakens any part of the green leaves of the potato plant in the latter part of the summer will proportionately decrease the yield. The popular notion to the contrary which is so frequently met is not so far as we learn based on careful experiments but is rather vague and theoretical. It seems to arise in part from a lack of appreciation of the importance to the plant of the green leaf and in part from a confusion of the physiology of tuber production in the potato with that of the fruit and seed production in tomatoes or similar plants.

V. POTATO SCAB EXPERIMENTS OF 1901 AND 1902

THE SUSCEPTIBILITY OF DIFFERENT VARIETIES OF POTATOES TO SCAB

One piece of land, a heavy clay loam, on the Experiment farm, has been used so frequently for potato culture during the last decade that the soil has become filled with the scab germ. A portion of this soil was used in trial plots in 1899 and in 1900 and the tubers were scabbed badly both seasons, in spite of the use of sulphur and other disinfectants.[1] It offered a favorable opportunity, therefore, to test the resistent powers of sundry varieties of potato to the scab fungus.

EXPERIMENTS OF 1901

In 1901 seed was secured of eleven varieties as follows: Carmen No. 1, Carmen No. 2, Crown Jewel, Delaware, Enormous, Green Mountain, Mammoth Gem, Nathan, New Queen, Sir Walter Raleigh, Uncle Sam. The seed was all free from scab spots, but the Delaware alone had been disinfected with formalin solution. The planting was done June 12, about four inches deep, digging October 22. Immediately after harvesting the tubers were examined and graded as to scab and it was found that practically every tuber of all varieties were more or less scabby. Any attempt to express their relative condition by figures would therefore be misleading.

Judging by the degree of scabbiness shown, two varieties, New Queen and Sir Walter Raleigh were more resistant than any of the others; Delaware and Carmen No. 1 stood next these in resistance; Uncle Sam and Green Mountain were most badly scabbed.

The resistance was in no case sufficient however to permit of profitable cultures of any of these on soil so conducive to the disease as that where this trial was conducted.

EXPERIMENTS OF 1902

In 1902 another trial was made on the same soil. The seed was all disinfected with formalin solution, the planting was done June 11, the digging on October 11. Fourteen varieties[2] were used. The name, position in the field and relative amount of scab of each is shown in the following table. Those marked "clean" had no scab spots, the "good" had one, two or three spots of scab, but as a whole would pass in the market as of good quality, while the "scabby" varied from tubers with several spots to those entirely covered with scab.

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[1] Vt. Sta. Rpt. 13, p. 273 (1900).

[2] The seed was secured as follows: Nos. 3, 4, 5, 14, from A. E. Manum, Bristol, Vt.; Nos. 1, 2, 12, 13, from E. L. Cleveland, Houlton, Me.; Nos. 6, 9, 10, 11, from H. F. Smith, Waterbury Center, Vt.; No. 7 from W. E. Johnson, Richmond Corners, Me.; No. 8 from Jones & Isham, Burlington, Vt.

In sorting it was noticed that the clean and good grades were more often the smaller potatoes which set late in the season, and in one or two cases none of these were large enough for table purposes. For this reason it appeared best to figure the percent clean and good on the basis of weight rather than of the number of the tubers, and this has been done in the following tabular summary of the results.

Number	Name	Total wt.	Scabby		Good			Clean		
			Wt.	No.	Wt.	No.	%	Wt.	No.	%
1	Green Mountain	66.5	56.3	265	10.2	85	15.3	3.5	45	5.2
2	Red Bliss	84.	78.3	499	5.7	90	6.7	1 6	37	1.9
3	Manu 's Seedling 11	31.5	26.3	144	5.2	50	16.5	1.7	24	5.3
4	Sir Walter Raleigh	66.	50.	256	16.	121	24.2	5.1	53	7.7
5	Enormous	87.5	64.7	231	16.8	74	19.2	4.8	38	5.4
6	Pingree	33.5	30.2	221	3.3	35	9.8	1.2	13	3.5
7	Pat's Choice	34.5	30.	198	4.5	52	13.0	1.5	19	4.3
8	New Queen	54.	51.	342	3.	45	5.5	1.5	26	2.7
9	Early Strawberry	79.	74.	694	5.	81	6.3	1.8	36	2.2
10	Joseph	34.	32.7	146	1.3	16	3.8	0	0	
11	Polaris	19.5	18.2	130	1.3	23	6.6	0.5	13	2.5
12	Beauty of Hebron	13.	13.	59	0	0		0	0	
13	Dakota	15.5	14.1	66	1.4	9	9.0	0	0	
14	Manum's Seedling 56	27.	15.5	47	11.5	41	42.5	4.5	19	16.6

Discussion of the results.—The varieties showing the greater degree of resistence to the scab in 1902 as indicated by the percents of "good" and "clean" tubers stand in the following order: Manum's Seedling 56, Sir Walter Raleigh, Enormous, Manum's Seedling 11, Green Mountain, Pat's Choice. It is worthy of note that the first four of these are from seed furnished by one potato breeder, Mr. Manum. Manum's Seedling 56 made an exceptionally good showing with almost 50 percent of merchantable tubers in striking contrast with the variety in the next row, Dakota, of which not a single tuber was free from scab.

A comparison of the results of the two seasons shows a considerable difference in the behavior of some varieties. Thus New Queen made a good showing in 1901 and a rather poor one in 1902, whereas the exact reverse is true of Green Mountain. Sir Walter Raleigh has a good record for resistance during both seasons.

The results are such at least as to lead to the hope that scab resistant varieties or strains may be secured by breeding and selection.

DISINFECTION OF SEED POTATOES FOR SCAB

The experiments of 1902 along this line were in continuation of those of 1901 and previous years. The plots were located as heretofore on recently cleared sandy soil not previously used for cultivated crops so far as known. Presumably it was free from scab germs.

The seed used in this experiment consisted of two varieties, Delaware and Rural New Yorker No. 2, selected from the crop from the scab plots of 1901. Those classed as "scabby" varied from tubers with one or two spots to those badly infested. On the average they would be classed as badly scabbed and unmarketable. The tubers of the Rural New Yorker were, on the whole, more scabby than the Delawares. Those classed as "smooth," while they came from the same plots as the scabby ones, showed no signs of scab. It is supposed that these would have the scab spores on them but to make this more certain they were rubbed with the scabby potatoes and some of the skin of the badly infested ones was scraped off and allowed to fall on them before they were disinfected.

The plantings were made in four long rows and the field was divided into five experimental plots according to treatment. Each plot contained one row of scabby and one row of smooth seed of each of the two varieties mentioned. Between the plots were check rows twenty feet long of another variety which had been thoroughly disinfected with formalin solution. The cultivation of all the rows was made in the same direction so that if any of the soil was carried from one plot to another the conditions would be uniform.

Treatment—For each plot one peck of scabby and one peck of smooth tubers of each of the two varieties was used and in all cases disinfection was performed within forty-eight hours before planting. Merck's formalin was used for plots I, III and IV.

Plot I. Formalin solution, 8 ounces in 15 gallons of water; soaked two hours in this solution.

Plot II. Corrosive sublimate solution, 10 ounces in 8 gallons of water; soaked 1½ hours.

Plot III. Formaldehyde vapor. In this treatment the tubers were first well soaked in water about half an hour and the many particles of dirt on the very scabby seed were carefully washed off with a brush. They were then placed while wet in a copper lined box upon open slat work shelves so that the vapor could easily come in contact with all sides of the potatoes. The scabby seeds were placed upon the lower and the smooth upon the upper shelf, and all openings in the box carefully sealed. The vapor was introduced through a hole in the bottom.

Novy[1] recommends for disinfecting hospitals and similar rooms, a distillation of 150 c. c. (5 ounces) of 40 percent formaldehyde to 1,000 cubic feet of space, in other words 0.15 c. c. for each cubic foot. At this rate, since the box contained only 8.2 cubic feet, 1.23 c. c. of formaldehyde would be required. Inasmuch as this amount was considered too small to be handled practically, and since it was believed

[1] Novy, F. G., Lab. Work in Bact., p. 529 (1899).

that a much larger amount could be used without injuring the seed, about ten times as much or 12 c. c. of formaldehyde was used.

The liquid was placed in a tightly corked glass flask from which a rubber tube extended to the interior of the box. Heat was then applied and the vapor distilled off as fast as possible. Unfortunately the flask broke before the liquid was entirely vaporized consequently not quite all the amount of liquid was distilled into the box. The box was kept tightly closed for twelve hours and when opened the odor of the gas was very strong.

Plot IV. Formaldehyde vapor and sulphur fumes. In this case the seed was first treated exactly as in the preceding lot (3) except that, before the formaldehyde vapor was introduced, a quantity of sulphur, 3 pounds to the 1,000 cubic foot, was placed in the box which was immediately closed. Again the flask broke just before the distillation of the formaldehyde was completed. At the end of twelve hours the odor of formaldehyde was as strong as in the first case but the sulphur had failed to burn. The box was allowed to remain open until the odor of the gas had practically disappeared. More sulphur was then introduced which burned completely, the seed being enclosed with these fumes for twelve hours.

Plot V. Untreated. In this case the seed was selected so as to be as nearly as possible like the plots I-IV but no disinfectant was used.

The planting was done April 25-28. There was no evidence of injury to the seed as shown by retarded germination in any case except plot IV, and in that it was not serious. The plants were cut back twice by the frost in the spring but recovered and made a good growth until killed by frost the first week of September. The tubers were dug and sorted about the middle of the month. The results are shown in the following table:

Plot number and variety	Condition of seed	Treatment	Smooth			Scabby			Tubers having more than two scab spots		
			Total wt.	Wt.	No.	Wt.	No.	%	No.	%	Aver'ge of each plot
Plot I.											
Delaware	Scabby	Formalin Sol....	136.0	127.6	1080	8.4	72	6.2	27	2.3	
"	Smooth	" " "	137.0	135.8	852	1.2	8	0.9	2	0.2	
R. N. Y.—2	"	" " "	131.6	127.6	873	4.0	27	3.0	13	1.4	
"	Scabby	" " "	125.5	112.4	708	13.1	68	8.7	28	3.6	1.91
Plot II.											
Delaware	Scabby	Cor. Sub. Sol....	152.4	140.3	936	12.1	56	5.6	32	3.2	
"	Smooth	" " "	163.9	163.3	1080	0.6	4	0.3	0		
R. N. Y.—2	"	" " "	130 8	129.1	791	1.7	9	1.1	2	0.2	
"	Scabby	" " "	132 5	108.6	812	23.9	148	15.4	86	8.9	3.11
Plot III.											
Delaware	Scabby	Formalin vapor..	104.2	93.3	661	10.9	64	8.8	26	3.5	
"	Smooth	" " ..	125 0	106.6	833	18 4	100	10.7	60	6.4	
R. N. Y.—2	"	" " ..	143.3	138.6	940	4.7	26	2.6	8	0.8	
"	Scabby	" " ..	145.0	140.9	753	4.1	17	2.2	5	0.6	2.88
Plot IV.											
Delaware	Scabby	For. gas-sulphur	103.9	91.3	675	12.6	59	8.0	25	3.4	
"	Smooth	" " "	113.3	89.0	732	24.3	130	15.0	72	8.3	
R. N. Y.—2	"	" " "	132.5	114.7	744	17.8	88	10.5	49	5.8	
"	Scabby	" " "	125.8	120.2	769	5.6	32	3.9	8	0.9	4.66
Plot V.											
Delaware	Scabby	Untreated	118.4	81.2	543	37.2	277	33.7	176	21.4	
"	Smooth	"	124.2	111.5	828	12.7	87	9.5	43	4.6	
R. N. Y.—2	"	"	160.7	124.6	918	36.1	226	19.7	144	12.5	
"	Scabby	"	142.6	65.2	553	77.4	638	53.5	436	36.6	18.84

Discussion of results.—As in all previous trials both corrosive sublimate and formalin solutions have proved about equally efficient. We have settled upon the use of formalin for our regular field operations because of its non-poisonous character and greater convenience.[1] The present experiments were to continue the trials of gaseous disinfectants. In the tests of the last two years[2] sulphur fumes and formalin vapor and gas have not proved as satisfactory as have the standard solutions of corrosive sublimate or formalin. In these former trials the tubers were dry when subjected to the gaseous treatments and the formaldehyde gas was generated by evaporating the dry tablets. This year the seed potatoes were *wet* when placed in the disinfecting box, it being hoped that the gas action would thereby be rendered more energetic; and the formaldehyde gas was generated by vaporization. Some of the details of the results in the above table are hard to explain. The combined gases were apparently less effective than was

[1] For a general account of potato scab and practical directions for disinfecting the seed, see bulletin 85 of this station.
[2] Vt. Sta. Rpt. 13, p 273 (1900), and 14, p 231 (1901).

the formalin alone. The greater percent of scab in both plots III and IV was found in the rows where smooth seed was used. The easiest explanation of both these matters is that there was contamination by the cultivator in the passage from the plot V. The outcome is satisfactory, however, as indicating that fumigation of the moistened tubers with formaldehyde vapor greatly reduced the scab. While we are not ready as yet to recommend this method as a substitute for that of soaking the seed we do feel hopeful that further trials will develop some satisfactory method along these lines.

ORCHARD DISEASES AND THEIR REMEDIES

I. SCABBING AND RUSSETING OF APPLES IN 1902

The apple scab fungus developed more destructively upon the foliage and the young fruit in the early part of the present summer, 1902, than we have heretofore known it to do. Owing to the excessive amount of rainfall, spraying was much interfered with or altogether prevented. In some cases where applications of bordeaux-paris-green mixture was made in early June a rusting or russeting of the fruit was evident in July, and in a few cases there was a spotting of the foliage which must be attributed to the spray.

About this time complaints of similar troubles were so general in other Eastern states and in Canada as to show that there was some common cause of wide occurrence. Beach and Stewart of the New York State station have made a special study of the conditions in that state and since they are like those encountered in Vermont, we quote in part from their statements.[1]

"After a careful examination of many orchards we have reached the conclusion that the trouble is due primarily to weather conditions and is aggravated by spraying. The protracted cold, wet weather in June made the foliage tender and susceptible to injury from the spraying liquids. Some unsprayed orchards show a little of the trouble, but sprayed orchards are almost invariably the most affected. However, some sprayed orchards are but slightly affected. In general, cultivated and well-cared-for orchards are less affected than uncultivated and neglected ones, but there are some exceptions to this rule. While spraying under the existing weather conditions is the principal cause, it appears that several other factors enter into the problem and modify the results. Injury has resulted from paris-green with bordeaux, "green arsenoid" with bordeaux, "disparene" (or arsenate of lead) with bordeaux, arsenate of lime with bordeaux, and an arsenical insecticide

[1] Rural New Yorker XLI, p. 532 (1902)

with bordeaux. It is clear, therefore, that each of the common insecticides has produced injury. Whether bordeaux alone is capable of doing it has not been determined. In the territory examined by us serious injury is not likely to result except, perhaps, in a few of the worst affected orchards. In the majority of cases the slight injury done by spraying is likely to be overbalanced by the good done. Notwithstanding the loss of foliage in sprayed orchards it is likely that where thorough and seasonable spraying has been done the fruit will be superior to unsprayed fruit; whereas, in unsprayed orchards the damage to fruit and foliage from scab and codling moth may be expected to increase. It would be unwise to forget the great benefits of spraying in the past and to denounce or abandon it because of the unfavorable experiences of this season."

A visit to the orchards of Grand Isle the present autumn gave abundant evidence of the gain from spraying. Although there was a very serious amount of damage from the russeting, the quality of the well sprayed fruit averaged much higher than did that of the unsprayed. The experience of this seasons suggests, however, that the strength of the mixture should be more freely varied to suit the period of growth, the climatic conditions, and the fineness of the spray thrown by the nozzle. The coarser the spray the weaker should be the mixture; in the early spring a stronger mixture may be used than in summer; in cold wet weather like that of last May and June the mixture must be made weaker or applied with a finer nozzle than in a warmer, dryer season. For the strongest mixture we would recommend six pounds of copper sulphate and four pounds of lime to forty gallons of water, and for the weakest mixture for use in orchards, two pounds of each sulphate and lime to forty gallons; probably four pounds of each sulphate and lime to forty gallons is the best average amount. We would strongly urge that the attention to orchard spraying be not lessened as a result of the condition of the past season.

II. STUDIES UPON PLUM BLIGHT[1]

In August 1901 the station horticulturist reported that a peculiar blight was developing in the experimental plum orchard. In appearance the disease closely resembled the "twig-blight" of pears and apples, and he suggested that it was possibly due to the same organism. The investigation of the matter was placed in charge of Mr. L. P. Sprague, then laboratory assistant in botany, and now of the Rhode

[1] This article is published entire in Centralblatt f. Bakteriologie, 2 Abt., IX Bd. (1902). Since the journal has not reached us when this copy leaves our hands, we cannot cite the page.

Island station. The following account is based largely on his results,[1] and to him is due the credit for the details of the work.

Occurrence.—The variety upon which the blight was first observed was Cheney (*Prunus Americana nigra*, on Americana stock). These trees were located in a row about ninety feet north of a badly blighting row of pear trees. The plum trees were four years old, growing in a well fertilized clay soil which had been kept moist by the frequent rains prevailing during the spring of 1901; and as a result, the trees had thrown out many vigorous young shoots to which the blight was confined. Similar conditions have existed during 1902 and the blight again developed in midsummer, being most conspicuous during August, although its inception evidently occurred earlier. All the branches from which the organism was isolated both years were of the Americana group; but the station horticulturist, who has observed the distribution of blighted twigs in the orchard both summers, states that it has seemed equally prevalent on various members of the Hortulana group. He concludes that its distribution has been determined rather by the location in the orchard in proximity to blighting pear trees than by the relative susceptibility of varieties.

Appearance.—Numerous young shoots scattered over each tree were blackened and apparently killed for from six to eighteen inches back from the tip, the general appearance closely resembling that of the twig-blight on neighboring pear and apple trees. The bark on these shoots was dark brown above, but this blended below into the normal color of the healthy twig. Several twigs were observed in which the appearance of blight was confined to the zones girdling each of several nodes, indicating that the inception of the disease occurred at or near the nodes and almost simultaneously at several places along the branch. On many of the shoots, but not on all, cracks had opened in the epidermal covering exposing a dry or nearly dry gummy matter. Upon cutting into the diseased twigs small pockets of nearly dry gummy matter were occasionally found. The diseased shoots near the tip were drying, while below they were still moist and flexible. The leaves were

[1] We were led to give more careful attention to this blight than its economic importance as shown in the present outbreak would seem to warrant, because the occurrence of a similar trouble has been reported to us on previous occasions and in other orchards. Moreover a serious outbreak of what seems to have been the same malady is reported by Sturgis, (Conn. [State] Sta. Rpt. 18, p. 117 [1894]). The disease is there described as destructively prevalent in a large plum orchard. Bacteria were found in the blighting branches and were thought to be responsible for the trouble, but they were not isolated and the matter was left for further study. It seemed that we ought to attempt to settle the question if possible when so favorable an opportunity was presented.

Since the completion of our studies we learn from Dr. E. F. Smith of the U. S. Department of Agriculture, that the pear blight organism has also been isolated from plums by Waite.

brown and dead as far back as the discoloration of the bark extended and, in the longer standing cases, had already fallen from the tip of the shoot. The inner bark in the lower and, hence, more recently blighted portions, was discolored—brownish—but still moist. Microscopic examination of this moist inner cortical tissue, just above the place where the diseased blended with the healthy bark, revealed myriads of bacteria, and the gummy masses were found to be filled with similar organisms. These organisms agreed in size and appearance with those from pure culture of the pear blight organism, *Bacillus amylovorus*. After careful removal of the outer portions with a flamed knife, bits of this discolored inner tissue were taken from the point where the discoloration was just beginning to show, including the cambium layer and the outer wood, and were used in making poured plates.

Several such plates have been poured at different times during the summers of 1901 and 1902, and by three different persons, L. P. Sprague, H. D. Bone and the writer. In every case the result has been an abundant development of white colonies, all of which, so far as tested, have proved to be the pear blight organism. To permit of comparison, plates were poured at the same time and in the same way from blighting pear twigs and the results obtained were like those from plum. As a quick method of testing the organisms thus isolated, inoculations were made into green pear fruits in August or early September, using Bartlett in the earlier part of the season and an unknown variety of small winter pear later. The method is substantially that suggested to us by Waite of the Department of Agriculture. The end was cut from the pear with a recently flamed knife and a needle stab inoculation of the organisms made into the exposed flesh near the core. The results were in all cases alike with the suspected organisms, whether secured from the plum or the pear, viz: in about 48 hours at room temperature, 20°-22° C, the exudation of pearly or opalescent, bead-like viscid drops, dotting the cut surface of the inoculated fruit, often some distance, 0.5 c. m. or more from the point of inoculation. These droplets were teeming with bacteria and microscopic and cultural examinations confirmed the conclusion that the organism was the pear blight bacillus. These droplets slowly enlarged in size until they merged together forming large drops, half covering the cut surface of the fruit and the general death and decay of the tissues soon resulted.

Numerous tests were also made by the method of direct inoculation into these green pear fruits of bits of the blighting stem-tissues from plum and pear, also with the gummy exudate from the blighted plum twigs. The result in practically all cases was the prompt develop-

ment of the opalescent beads teeming with organisms which appeared to be identical, whether plum or pear tissues were used for the initial inoculations. To place the matter beyond possible doubt, however, careful cultural studies were undertaken by Mr. Sprague, who carried the two strains of organisms—one obtained from blighting pear, the other from blighting plum—through parallel series of cultures extending over eight months time and including a variety of media and leading to still more conclusive inoculation experiments. In every detail the behavior of the two strains was identical.

Inasmuch as there has been no record of the behavior of this organism upon many of the culture media tested, and since the facts observed were in some respects different from those given in Chester's description,[1] it seems worth while to give the following brief summary of the morphological and cultural characters observed. In all cases the methods and media employed were, unless otherwise stated, like those used in the studies of *Bacillus carotovorus*, discussed in the thirteenth report of this station, p. 314. The cultures were grown at approximately 30°C.

MORPHOLOGICAL CHARACTERS

Form.—A bacillus; usually single or in pairs, sometimes chains of threes and fours in young cultures.

Size.—(In microns) Young broth cultures, 0.9 to 1.5 long by 0.7 to 1 wide; longer (up to nearly 3) and slightly narrower in older broth cultures.

Grouping.—Slight tendency to pellicle formation and numerous small zoogloea masses in broth cultures.

Staining.—Stains readily with usual watery or alcoholic solutions, also by Gram's method.

Capsule.—None observed.

Flagella and motility.—Fairly motile in young cultures, less so in old ones. Flagella stains (Lowits' method, from 24-hour agar slants) not satisfactorily made but showed several peripheral flagella apparently 4-8 microns long; also structures doubtfully considered giant whips, 14 to 34 microns long.

Spores.—None demonstrated.

PHYSIOLOGICAL CHARACTERS

Nutrient broth.—Good growth; clouding perceptible in 8 hours, increasing to third day but never heavy as compared with *B. carotovorus*, *B. coli-communis*, etc.; pellicle and rim slight; moderate amount of gray-white deposit.

[1] Chester, F. D. Manual of Determinative Bacteriology, p. 176 (1901).

Gelatin.—Plate; buried colonies spherical, granular; surface colonies white, margins entire; *tube:* slow crateriform liquefaction confined to upper layers.

Agar.—Plate: buried colonies white, spindle-shape or spherical, granular; surface colonies white, circular, elevated, wet-shining, margins irregular; *stab:* growth along entire length; *slant:* white, wet-shining streak, thin along middle, heavier along sides, margins wavy, spreading in a few days over surface of slant.

Carbohydrate-agars: more rapid growth induced by additions of 2% of cane or of grape sugar or of maltose or of 5% of glycerine. No gas in shaken tubes of plain agar or in above named carbohydrate agars.

Milk.—Coagulation in 3 to 4 days, followed soon by gradual digestion to a pasty condition with separation of supernatant whey, no color. (Above is usual course but in some cases digestion set in before coagulation was complete, in others digestion was slower.)

Blood serum.—Growth similar to agar. No liquefaction.

Dunham's solution.—Rapid growth but clouding not dense, no pellicle or rim or zoogloea masses and deposit slight.

Cooked vegetables.—Slanted cylinders partially immersed in water; potato, carrot, beet, turnip. Good growth in all, best in beet, weakest in turnip. In all alike a wet-shining white streak along line of inoculation; liquid heavily clouded, white and nearly opaque. Tissues not softened, no odor, gas or pigment.

Temperature relations.—Optimum 25-30° C; no growth at 0.5° C (broth); very slow growth at 3° C. Recently inoculated broth tubes were rendered sterile by 10 minutes immersion in thermal bath at 43.7° C and similar exposure at 43° C retarded growth.

Oxygen relations.—Facultative anaerobe. Slight growth in closed branch of fermentation tubes, and in tubes sealed immediately after inoculation; very slight in oxygen-free atmosphere (Buchner method); slight in hydrogen; no appreciable growth in carbon dioxide.

Acid and alkali production.—There is a slight excess of acid development in most media during the first few days (e. g. milk, broth). but this is soon overcome by a predominence of alkali production. (Litmus milk: color bleached before perceptible reddening. Rosolic acid peptone solution faded but original color returned after two weeks. Milk cultures titrated against phenolpthalein as follows: Before inoculation 2.1%; 5th day, 3.0%; 8th day, 2.6%, 17th day, 1.4%.)

In the presence of certain carbohydrates there was a predominence of acid development. Thus broth cultures tested with litmus paper

reacted as follows: all before inoculation being alike distinctly alkaline to litmus (neutral to phenolpthalein):

Plain broth: Progressive slight decrease of alkalinity during first week, at no time reaching point of acid reaction, then gradual return to alkalinity during second and third weeks to original reaction at end of month thereafter remaining constant.

Broth+2% saccharose.—Progressive loss of alkalinity during first three days, neutral on fourth, progressive increase of acidity until on the fourteenth day it was distinctly acid.

Broth+2% glucose.—Acid development slightly slower than in cane sugar but the condition the same on the fourteenth day.

Broth+2% lactose.—Little if any change in reaction during two weeks.

Reduction processes.—Nitrate-broth showed no development of nitrates. Litmus milk and rosolic acid peptone-water both showed progressive bleaching during the first week (less rapid than *B. carotovorus*); during the second week color slowly returned, reaching original condition at end of fourth week.

Indol.—Considerable produced (less than *B. coli-communis* but more than *B. carotovorus*).

Hydrogen sulphid.—None detected from broth cultures.

Odor.—No characteristic odor perceived from any culture.

Desiccation.—Drying on cover-glasses, at about 20° C, for various periods up to 5 days had no appreciable effect; 16 days caused slight retardation in development; 76 days was fatal.

Insolation.—Ten minutes exposure of freshly poured agar plates to March sunlight retarded development somewhat; 30 minutes was fatal.

Gas production.—None in shaken tubes of carbohydrate agars (see agars); none in fermentation tubes containing broths with 2% of either glucose, saccharose, lactose, or glycerine.

Pigment.—None; growth white or grayish-white on all media used.

INOCULATION EXPERIMENTS

These have included numerous repetitions of the inoculations into green pears (one-half to three-fourths grown) following the method previously described and practically always with like results. The fruit in these cases was placed in a closed chamber at 20°-22° C. Inoculations were also made at two different times with a pure culture of each strain (from plum and from pear) by needle stabs into immature Bartlett pears which were left clinging to the parent tree. In every such case the inoculations led to similar results, namely, the death and browning of the tissues, accompanied by the exudation of numerous white viscid bead-like droplets upon the surface first about the point

of inoculation, and, later, over the entire surface. The blight thus started usually invaded the fruit spurs and in some cases girdled the parent branch.

Inoculations made into detached pear fruits approaching maturity gave less prompt and characteristic development than with the younger fruits and greater liability to contamination.

Inoculations with pure cultures made in the same way into sectioned, detached, unripe plums, led to a development similar to that on the pears, as evidenced by the exudation on the cut surface of beaded drops teeming with the organisms. These drops were, however, less milky in color than those from the pears, indicating a less vigorous development of the bacillus. As the plums approached maturity such inoculations were not uniformly successful. Stab inoculations into seven unripe plum fruits, left clinging to the tree, led, in three cases, to the death and decay of the fruits, which was apparently caused by the development of the organisms inoculated; but in none of these cases did the disease extend into the twig.

A second series of inoculations into the plum fruits as they were approaching maturity led to no development or decay.

Numerous inoculation experiments were undertaken in September, using pure cultures of both strains, into young (first year) shoots of plum and pear in the orchard. These included some sixty inoculations into as many different twigs, some of the wounds being covered with sterile grafting wax, and some with moistened paper and cloth. In no case was there any signs of infection or blight as a result.

During the winter seedling plums were grown in the green house. When these were a few inches high, in February and March, inoculations were made by needle punctures near the tip into 18 plants, agar cultures being used, including both strains of organisms. None of these caused blight. These inoculations were twice repeated with the same negative results.

At the same time seedlings and cuttings of pears were started. Only one of the seedlings grew. This was inoculated (about March 1) by needle puncture near the tip of the stem from an agar culture of the plum blight strain of the organism. Blight developed promptly so that at the end of five days the stem was blackened from the point of inoculation to its apex and, also, nearly to the base, and the discoloration was invading the petioles and bases of the leaves. At this juncture a poured plate was made from the interior tissue of one of these blackening leaf bases, the original organism found in abundance and recovered in pure culture.

The only plants available for further inoculation tests in pear at this time were cuttings made in the autumn and started in sand. These

were now well clothed with young shoots and six of them were selected for the trial. A needle prick inoculation from a young agar culture was made into the base of each of three of the young shoots of each stem. Of the 18 shoots thus inoculated 9 (on 3 stems) were from cultures taken from the plate obtained from the blighting leaf just mentioned above, 6 (on 2 stems) were from the original plum strain of the organism and 3 (on 1 stem) were from the pear strain. Every shoot inoculated developed the characteristic blight within three days from the date of inoculation, and, at the end of a week, every such young shoot was dead and the blight was spreading both up and down from the base of the shoot as shown by the discoloration and sinking of the bark. The characteristic viscid, opalescent drops of exudate, were found in places upon all, teeming with the organisms. In some cases it was so abundant as to coalesce and run down the stem, or, upon partial drying, to gum the leaves together or to the side of the stem. In all cases the behavior was similar and typical of pear blight.

It was planned that the inoculation experiments should continue farther and include a repetition of those upon pear and plum twigs in the orchard in the spring and early summer. Mr. Sprague, however, having been appointed assistant horticulturist at the Rhode Island Station, removed from the state and was unable to carry on the work; nor was it practicable that the trials could at this time be further prosecuted.

In conclusion we may briefly summarize the results of the inoculation experiments as follows:

The two strains of organisms, from plum and from pear, behaved alike in all cases.

Inoculation into unripe pear, either with bits of diseased bark or of pure cultures, led alike to characteristic growths. Ripening lessened susceptibility of the fruit.

Inoculations into sections of unripe plum led to growth only under favorable conditions. Inoculations into ripening fruit failed altogether.

Inoculations into plum branches were in no case successful.

Inoculations into pear shoots failed when they were in a semi-dormant condition (September), but led to rapid blighting when vigorous growth was occurring.

It is seen at once that these results fall of complete solution of the problem undertaken, in that successful inoculation of plum branches was not accomplished, although they leave no doubt it our mind that the pear blight bacillus is the cause of the plum blight. It is shown conclusively that the plum is much more resistant to the invasion of the blight organism than is the pear, and infection, probably, is pos-

sible only when conditions are peculiarly favorable during spring and early summer—a season of the year when no inoculations were attempted.

THE CULTIVATION OF THE LOCUST TREE [1]

There are small areas of sterile sandy soil scattered through Vermont, especially in the northern Champlain and southern Connecticut valleys, which are not profitable for ordinary agricultural purposes. These were originally covered with forest growth probably consisting largely of the pitch pine (*Pinus rigida.*) Owing to its natural adaptation to this soil and to its abundant seed production, this species has taken almost complete possession of the dryer of these soils where they have been abandoned to second growth of trees. This pine is the least valuable of the evergreens. If these lands are to be given over to sylviculture it is a question whether it is not worth while to have the ground occupied by something better. The moister and less sterile of the sandy soils are, of course, admirably suited to white pine, and certainly where this develops naturally it is the most profitable tree to grow.

The University owns a tract of the most barren type on the sand plains east of Burlington. The entire area was, until recently, covered with pitch pine, but this was cut clean between the years 1892 and 1896. This method of harvesting the crop was perhaps not the wisest with reference to its reproduction. The soil is so dry and the seed trees of any kind left are so few that another crop of trees has been very slow in starting. It has seemed worth while to do some experimental planting on this area and this has been done in the spring of each of the years 1897, 1898 and 1902. The species used in these trial plantings have included white pine, Norway spruce, European larch, red oak, chestnut, white birch, cottonwood, box-elder and the common locust. Most of these trees have not stood long enough to justify any detailed report. Suffice it to say that the two that now promise best returns are the white pine and the locust. The question of white pine cultivation is one of great importance in sections of the Champlain and Connecticut valleys, but we are not prepared to contribute anything to it at present other than its general commendation. The experiments with the locusts, however, have progressed sufficiently far to justify a

[1] The tree referred to (*Robinia Pseudacacia, L.*) is commonly planted about farm houses throughout Vermont and is popularly known simply as the locust; sometimes, however, the names yellow and black locust are used. It has in many places spread along the roadsides, occasionally forming dense thickets. It is not a native of Vermont, being found wild only from Pennsylvania south and west.

preliminary report, inasmuch as the outcome is already so promising as to lead us to suggest that trial plantings of this tree ought to be made by such as possess suitable soils.

RECORDS OF OUR PLANTATION

One hundred seedling trees, height about 12 inches, were bought in 1897 and set in rows four feet apart each way. These were planted rather late in the spring and, probably owing to this fact and to the sterility of the soil, only 57 of them have survived. Numerous sprouts have come up from the roots so as in a measure to make up for the number that have died. The young locusts have made a remarkable growth, far outstripping any other trees in the plantation. In the spring of 1902[1] they averaged ten feet in height and over two inches in diameter at the base, some being nearly three inches. Practically all of this growth has been made during five years. That their development will probably continue at a similarly rapid rate is shown by measurements made upon seedling trees growing spontaneously upon similar soil nearby in the same field. These are 11 years old, 16 feet high and 5 inches in diameter at the base.

On similar but somewhat cooler and moister soil, of a northerly slope,there is a roadside thicket of locust trees of various ages from which the following data has been obtained. The trees make a uniformly rapid growth for thirty or more years, averaging, during this time, an increase in diameter at the base of nearly one-half inch each year. Thus of two typical young trees each 19 years old in this thicket, one was 8 inches, the other 10 inches in diameter one foot above the ground.

LOCUST ROOTLETS
Showing nitrogen-gathering nodules

[1] For these measurements we are indebted to Mr. L. E. Grout, who, as a student in the Agricultural Department of the University, made "The Reforestation of the Sand Plains" the subject of his senior thesis investigation.

Both of these, growing as they were in a crowded grove, had pushed up straight and tall and possessed fully twenty-four feet of clean trunk which is sufficient for three fence-post lengths. These figures show a rate of growth rather below than above those usually given for the locust and they are probably somewhat less than occurs in richer soils. An explanation of the relatively rapid growth of this tree in sterile sandy soil lies in the fact that it belongs to the legume family and, like the clovers, peas, etc., acquires its nitrogen from the air.

From the data given it seems probable that twenty years from the setting the trees upon this sand plain plantation many of them will be from 8 to 10 inches in diameter at the base and will therefore make good posts. It will doubtless pay, however, to cut some for stakes earlier than this, in order to thin them and then, at the end of the twenty years, to cut only the largest ones, allowing the others to stand a few years longer.

Encouraged by this small trial planting, 5,000 more seedling trees 12 to 18 inches in height were bought and set out early in April, 1902. Ninety-two percent of these trees are alive and making a rapid growth at the end of this first summer and there is no doubt that these are all well enough established now to be beyond further danger. The station farm superintendent has had charge of the fitting of the ground and the planting of these trees. He estimates the expense as from $20 to $25 per acre. To this must be added the cost of the trees, $3.50 per thousand, 2,560 trees per acre, which is $7.68. It has been our practice to plant potatoes between the trees and cultivate them for the first year or two, and this crop has more than repaid the expenditure for fertilizer and for the cultivation.

THE VALUE OF THE CROP

Locust timber is used for numerous purposes including posts of various kinds, telephone and other poles, ship-building, pins and railroad ties. It probably has greater value for fence posts than for anything else in this locality. Locust posts, as is well known, will outlast any other kind used in Vermont unless it be the red cedar. If well seasoned before setting, a locust post will stand from 30 to 60 years. It is worthy of note in this connection that the slower grown wood from dry sandy soil, like that under discussion, makes the most lasting and, hence, the most valuable posts. Locust posts are rarely quoted in our markets but a reliable dealer informs us that he could afford to give more for them than for similar sized white cedar posts. A recent writer in "Forestry and Irrigation" (A. Neilson, August, 1902) places the value of board-fence posts at 20 cents and wire-fence posts at 10

cents each. One can from the data at hand estimate the return from the locust plantation although such estimates can rarely take into full account the various sources of expense or loss unless they are based on previous experience. We have planted 2,560 trees to the acre. Assuming that the value of poles cut during their development will pay for the work of pruning and thinning and that one-fourth of the trees are standing and suitable for posts at or about the twentieth year, there will then be 640 trees to the acre, each of which may be expected to yield two board-fence posts and one wire-fence post. Estimating these at 15 and 10 cents respectively gives a valuation of 40 cents a tree or $256.00 an acre. The expense of cutting must be deducted from this but there will be the value of a considerable amount of fuel to be added. It would seem, therefore, that a very profitable crop is assured after making all reasonable allowances. The greatest element of uncertainty is the danger from borers, which is discussed later. They have as yet done little damage but may become more serious.

In view of the increasing demand for and the decreasing supply of posts it would seem a wise investment for many farmers to start at least a large enough locust plantation to supply the posts needed on the place, and some might find that several acres given to locust culture would be profitable.

SUGGESTIONS FOR PLANTING[1]

The trees are easily started from seed planting one-half inch deep in light garden soil; or the seedlings can be bought very cheaply from nurserymen as was done in the present case for $3.50 per thousand.

After the locust is once established it will continue to reproduce itself by coppice growth, since it sprouts vigorously from the stumps and roots following each cutting. This second growth pushes up more rapidly than the seedling plants and presumably, therefore, will be the less liable to trouble from borers. In the roadside thicket from which we obtained some of our data such second growth sprouts three years old were from one and one-half to two and one-half inches in diameter at the base. There will be no cost for renewed planting, therefore, and a second crop of posts can probably be cut in from 12 to 18 years after the first is removed.

MIXED PLANTATIONS

The chief element of uncertainty in the cultivation of the locust is, as has already been suggested, the danger from borers. At

[1] The seed may be planted as soon as collected. If kept dry for any length of time it should be soaked for a day in warm water before planting. It is said that one pound of seed is sufficient to sow in a nursery row 900 feet long.

times, especially farther west, these pests so riddle the trunks of the young trees as to greatly lessen their value and, in some cases, actually to kill the trees. Serious damage from these insects is usually confined to the young trees which are lacking in vigor. In order to lessen this danger efforts should be directed to keeping the trees in thrifty growth for the first dozen years. It is also stated that the best growth and, hence, lessened trouble from borers results when they are mixed in plantations with heavier foliaged trees. The explanation of this is that the locust alone does not form dense enough shade to keep down the grass, weeds and other undergrowth. For this purpose the catalpa and mulberry are recommended farther south since they cast a heavy shade and do not grow fast enough to overtop the locust. Since neither of these two species is well adapted to our climate, we have made trial plantings of a number of other kinds of trees. The desideratum is a heavy foliaged tree that will not overtop in its growth the locust and which will of itself be of value. The white and pitch pines, elm, canoe birch, black cherry and box-elder are all claimants for favor. We are inclined to choose the white pine, however. In order to force the young trees into the straight tall growth which is essential, thick planting is necessary. In most cases 4 by 4 or 3 by 6 feet is recommended. It is said that it is sufficient to plant every third row with the shade giving species in mixture, that is, with the white pine or some similar tree.

KILLING WEEDS IN LAWNS

Since our earlier publication relative to the successful use of salt in killing the orange hawkweed, or paint brush,[1] and of copper sulphate in destroying "kale" in oat fields,[2] we have received numerous requests for like specific remedies for various other specific weed troubles. In most cases it has been necessary to reply that none was known; but the repeated questions from so many sources have shown the need of more exact information along these lines. The use of herbicides is bound to increase in the near future just as that of insecticides and fungicides has done in recent years. There are many caustic and poisonous byproducts of sundry industries which are fatal to plant life, of low cost and of great abundance. These will increasingly replace the expensive hand labor now so generally used in hoeing out roadside gutters, scraping tennis courts and raking gravel walks. We have been led, therefore, to continue experimental trials of herbicides.

Attention has been this year directed to some of the more common and troublesome lawn weeds. Apparently most of the coarser, deep-

[1] Vt. Sta. Bul. 56 (1896).
[2] Vt. Sta. Rpt. 13 (1900), p. 284.

rooted perennials can best be combated by frequent spudding or cutting out and close mowing accompanied by proper fertilization, watering and abundant seeding with the proper lawn grass at favorable seasons. Dandelions, plantains, white daisies, and the docks are best dealt with in this way. These plants all have a distinct "crown" near the surface. A remedy used with some success against these pests consists of the application of a few drops of a strong acid to the center of this crown. Sulphuric acid may thus be applied with a glass tube. or crude carbolic acid with a common metal oil can. In most cases however, we believe spudding to be the better method.

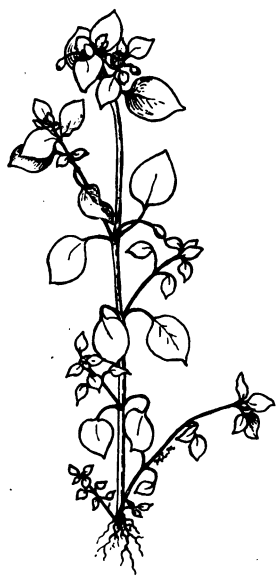
There is another class of weeds which are very shallow-rooted and succeed even under close mowing because of their creeping habits or because of the abundant production of seed on prostrate stems. The orange hawkweed, or paint brush (*Hieracium aurantiacum*), smaller crab-grass (*Panicum lineare*) and common chickweed (*Stellaria media*) are three of the more troublesome of this class. The trials first reported in bulletin 56 of this station showed that salt, when properly applied, is a perfect remedy against the hawkweed. It has seemed worth while to try it, along with various different remedies and methods, against the other two weeds. The outcome in the case of the crab grass has not favored the use of salt but with the chickweed it has proved a very satisfactory herbicide as the following accounts will show.

CHICKWEED

These trials were made on a well fertilized and closely mowed lawn on a rather heavy clay soil, sloping gently to the east. The turf, where good, was mainly Kentucky blue-grass with some timothy, redtop, and white clover. In the areas chosen for trial the chickweed was so abundant from midsummer on as almost completely to overtop the grasses and clovers. Indeed the sensation on stepping on it was not unlike that afforded by a bed of sphagnum moss.

Plot	Date treated	Treatment given	Condition Sept., 1902
1.	Oct., 1901.	Heavy sowing of grass seed mixture without raking.	No appreciable benefit.
2.	Oct., 1901.	Thorough raking to tear out chickweed, followed by heavy seeding with grass mixture.	Some improvement, but not satisfactory.
3.	May, 1902.	Same as 2, but using redtop seed.	Unsatisfactory, though some improvement.
4.	May, 1902.	Same as 2, except that raking was done with extra thoroughness.	Fair stand of grass and not much chickweed.

5.	June 15, 1902.	Scattered dry salt at rate of 2 qts. per sq. rod; followed by raking and sowing seed mixture.	Lawn grass somewhat browned at first, now fully recovered and a good stand; all chickweed and white clover killed.
6.	June 25, 1902	Same as 5, except that seed was more thoroughly raked in.	Perfect success; no browning of grass; grass shows excellent stand; all chickweed and clover killed.
7.	June 25, 1902.	Same as 6, but no salt applied.	Condition good, but considerable chickweed remains; not equal to 6.



CHICKWEED

These trials are being continued but the results to date seem to justify the following:

Conclusions.—1. Treatment either by raking or by the sowing of salt or both combined were far more effective against chickweed when made the last week of June, than when made earlier in June, in May or in the late autumn. This was possibly in part due to the fact that the growth of chickweed was farther advanced and, doubtless, in part to the dryer and hotter weather prevailing then and immediately thereafter.

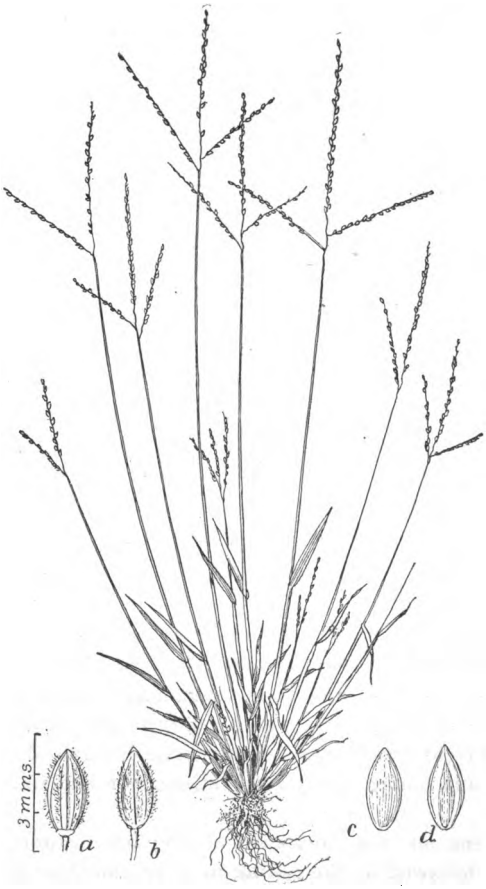
2. Tearing out the chickweed at this time (June 25) by a thorough raking followed by the raking in of an abundant seeding of grass, destroyed most but not all of the pest.

3. The application at a dry time (June 25) of two quarts of salt to the square rod, followed by the thorough raking out of the chickweed, and by a liberal sowing of grass seed well raked in, was completely successful in exterminating the chickweed and in securing a full stand of grass.

We suggest that any one employing salt on a lawn do so cautiously and on a small scale at first as the effects will doubtless vary somewhat with soil and season.

CRAB-GRASS

Plot 5 was the only one of the series referred to above, where crab grass was abundant. The treatment there given (dry salt, thorough



THE SMALLER CRAB-GRASS. (After Scribner, U. S. D. A.)

raking, sowing grass seed in the middle of June) was ineffective. This pest is so entirely different in its nature from chickweed that it is not to be expected that it can be controlled by the same method. To fight crab-grass successfully one should understand the following facts concerning it:

It is an annual grass, no roots living over winter. It forms an abundant crop of seeds on the spreading finger-like branches terminating the stems. These appear and ripen quickly from midsummer on, but most abundantly in late August and September. If the grass were not mowed, these would be erect or ascending, but under close cropping with the lawn mower they become practically horizontal and, lying prostrate in the lawn grass, they escape cutting and ripen their seed undisturbed. The plant grows best in a light, dry, warm, sandy soil and its seed does not germinate until the soil becomes thoroughly warmed up in June, indeed little is seen of it in the lawn until late in July. It is evident, therefore, that there is time to get a good stand of timothy and white clover started from seed sown in the autumn or early spring before this weed grass can germinate. This is especially true in a moist, cool season like the last one, and this condition can be favored any season by the use of fertilizers and the water sprinkler.

The specific methods we recommend to get this grass out of lawns and to keep it out, are as follows:

1. Be sure that none is introduced in the grass seed.

2. Use grass seed, fertilizer and water freely as needed to keep a full stand of grass in vigorous growth.

3. If but little of the crab-grass appears in the lawn, weed it out by hand.

4. If it occurs in considerable amount, in late summer and autumn rake the place where it occurs before using the lawn mower so as to raise the prostrate seed-stalks high enough to insure that they are all cut off. Repeat the raking and mowing frequently,—once a week or oftener, during the autumn, to prevent the maturing of seed so far as possible.

5. Remembering that this weed grass will die during the winter, make a heavy sowing of grass seed in early spring so that all bare spots in the lawn are promptly covered with a new growth in the early spring and the new seeding fully established before the crab-grass seed germinates in the early summer.

6. For such seeding use a mixture of timothy and Kentucky blue-grass with *much white clover*.[1] Ten pounds of timothy, ten pounds of

[1] For more detailed account of methods of making and seeding lawns, see bulletin 94, on Vermont Grasses and Clovers.

blue-grass and two pounds of white clover is a well proportioned mixture for most soils; but in fighting this weed grass we have found it desirable to increase the relative amount of clover seed, especially on sandy soil. Be sure to keep the newly seeded lawn well watered.

7. In starting a new lawn aim to secure a soil for the surface layer which is free from the seeds of this pest. In seeding this do not depend on the "lawn grass mixtures" of the trade, but get the three varieties named above, avoiding the use of the coarser clovers (red and alsike), or the annual grasses(ray-grass,etc.), which occupy the ground but a short time and then, dying, leave vacant places to be invaded by weeds.

REPORT OF THE HORTICULTURIST

F. A. WAUGH

The work of the horticultural department during the past year has followed much the same lines as hitherto, dealing especially with orchard fruits,—apples, plums and cherries. Some interesting experiments in pruning were begun, but they are yet far from finished. It happens, somewhat by accident, that all the matters which are ready for publication in this report have to deal in some way with plums, though the one on propagation has a wide application in one of the most fundamental processes of horticulture.

The report is submitted under the following heads:

Propagation of Plums—Third Report.

A Review of the Americana Plums.

The Grouping of the Japanese-Hybrid Plums.

PROPAGATION OF PLUMS—THIRD REPORT

Two reports on this subject have already been made.[1] Those who wish to follow up the subject closely should consult those publications. The data and the generalizations therein given will not be repeated here, since neither those articles nor this one is final. All three are merely reports of progress.

I. SCOPE AND LIMITATIONS OF THE EXPERIMENT

Our experiments, as originally planned, were expected to throw some light on the old, important, difficult and much neglected question of the influence of the stock on the character of tree and fruit. For this purpose a number of different kinds of plums were grafted upon a number of different kinds of stocks, according to a well-matured plan. No striking nor immediate results were expected. At the outset this was intended to be merely an orchard experiment, one which might require us to wait several years before yielding any data applicable to practical horticultural affairs.

It came somewhat in the nature of a surprise to find that the various lots of trees behaved very differently in the nursery. The very first year there were remarkable and important differences observable

[1] Vt. Sta. Rpts. 13, p. 333 (1900); 14, p. 257 (1901).

among them,—differences for the most part undoubtedly due to the different influences of varying stocks. These developments were interesting, and in many points seemed to be of practical consequence. In certain ways they appeared to have some significance for the tree planter; but for the most part they were, naturally, of greater interest to the tree propagator,—that is to the nurseryman.

They were published, therefore, chiefly for the benefit of the nurserymen, by whom they were received with considerable interest. The experiments were republished and reviewed in the nursery papers, and we received many letters on the subject from nurserymen who were interested in the propagation of plums. On this account, one suggestion made by several of our friends among the nurserymen should be given attention here. This was that, since the majority of propagators usually bud and seldom graft plums of any sort, it would have had a more practical bearing on nursery practice had our propagations been made in the same way. (Our propagations were all by root grafts.) If the experiments had been undertaken primarily for the benefit of the nurserymen, this suggestion would have great weight, and probably budding instead of grafting would have been the method employed from the first. The original aim, however, was simply to get a certain number of very diverse varieties of plums growing on a certain number of very diverse stocks; and the way to do this with the greatest expedition, certainty and uniformity seemed to be by the well-known and well-accredited plan of root grafting.

It may be said that the experience of three years (including four grafting seasons) has fully confirmed us in our original belief. For the last two years we have been making efforts to duplicate our experimental tests by budding; but so far from realizing any appreciable success, the work has been, from the experimental standpoint, almost a total failure. In this year's experiments, for example, we have been using the following stocks for grafting: Americana plum, Sand cherry, peach, Marianna plum, Myrobalan plum, St. Julien plum, and Bird cherry. Anyone with even a beginner's experience in nursery affairs will know how difficult—practically impossible—it is to grow budding stocks of so many very different species and have them all reach budding size together. We have never been able to get a good stand of peach stocks in our soil and climate. Our Americana stocks are usually too slender to bud satisfactorily. Sand cherry never makes a good budding stock under any circumstances. Bird cherry, on the other hand, grows too large and rank and too late into the season. We have thus found it quite impossible at any time to get a uniform series of plums budded on the various stocks which we wished to use. For these

reasons we are continuing our use of the root grafting method with little prospect of changing.

II. NURSERY EXPERIMENTS OF 1901

The nursery experiments of 1901 were carried on along lines closely parallel to those followed in 1899 and in 1900. Five different varieties were propagated on five different stocks. The five varieties, representing five distinct classes of plums,—the most important classes in cultivation,—were as follows:

Stoddard, of the Americana group,
Bavay (*Reine Claude*), of the Domestica group,
Chabot, of the Japanese group,
Milton, of the Wildgoose group,
Newman, of the Chicasaw group.

The five stocks employed were as follows:

Americana, seedlings grown in Iowa,
Miner, root cuttings grown in Iowa,
Marianna, grown from cuttings in Maryland.
Peach, seedlings grown in Maryland,
Sand cherry, seedlings grown in South Dakota.

Each variety was grafted upon each stock, making twenty-five lots in all. Sixty grafts were made in each lot, one-half of which were planted in Maryland and grown in the nurseries of Mr. J. W. Kerr for the first year, while the other half were planted on the grounds of the Experiment station at Burlington, Vt. The grafts were made by the whip-graft method, and the work was done by Mr. Kerr, one of the best known propagators of plums in America. They were handled according to the methods most approved for this sort of grafting.

The report on the grafts planted in Vermont is soon made. Their growth was so scattering and irregular that the entire lot, though showing many good individual trees, was judged useless for purposes of comparison. The general result was another—and quite unnecessary—accumulation of evidence to the effect that nursery stock can not be profitably produced in Vermont.

The grafts planted in Maryland, with the exception of Bavay, did well. At the end of the year they were dug and shipped to the Experiment station, where our notes were taken and our measurements made.

The results with Bavay were so thoroughly unsatisfactory that it would be a waste of time and space to give them record here. They are therefore omitted. Brief descriptive notes of the remaining lots are tabulated herewith.

NOTES ON ONE-YEAR-OLD TREES GROWN IN MARYLAND

Description		Tops	Roots			General notes
Variety	Stock		Tap roots	Secondary roots	Fibrous roots	
Stoddard	Americana	Slightly branched	Irregular	Few	Moderate	Fair
	Miner	Small, irregular, straight	Straight	Few	Very few	Only fair
	Marianna	Nearly straight	Nearly straight	Several	Few	Good
	Peach	Slightly branched, irregular	Slightly gnarled	Several, irregular	Moderate	Fair
	Sand cherry	Strong, straight	Straight	Many, strong	Many	Fine
Chabot	Americana	Straight	Slightly twisted	Few	Moderate	Fairly good
	Miner	Small, branched	Straight	Few	Few	Poor
	Marianna	Straight	Strong, straight	Many, strong	Moderate	Very good
	Peach	Slightly branched	Some twisted	Several	Few	Fairly good
	Sand cherry	Strong, considerably branched	Very strong, somewhat twisted	Many, strong	Many	Very fine
Milton	Americana	Slightly branched	Slightly twisted	Moderate	Few	Good
	Miner	Straight	Straight	Hardly any	Few	Fair
	Marianna	Straight	Straight	Few	Few	Fair
	Peach	Somewhat branched	Somewhat twisted	Several	Few	Fair
	Sand cherry	Considerably branched	Strong	Many, strong	Moderate	Fine
Newman	Americana	Moderately branched	Nearly straight	Several	Moderate	Very good
	Miner	Moderately branched	Straight	Few	Few	Only fair
	Marianna	Small	Straight	Many	Moderate	Very good
	Peach	Slightly branched	Somewhat twisted	Several	Moderate	Good
	Sand cherry	Moderately branched	Strong	Irregular	Many	Fine

It will be seen that the trees on Miner roots were generally poor, while those on Sand cherry were uniformly fine. These results will be made plainer in the measurements shortly to be given.

Those results, which may be computed numerically, are given in the following table. The caliper measurements were made just above the collar. The trees were, on the whole, fairly good one-year-old plants of the varieties named.

MEMORANDA OF TREES

Description	Total number trees	Average height feet	Average diameter inches	Ratio of height to diameter
Stoddard:				
On Americana	10	2.10	.29	88
On Miner	9	2.33	.28	98
On Marianna	18	3.04	.33	112
On Peach	13	2.95	.32	110
On Sand cherry	18	3.63	.36	122
Chabot:				
On Americana	20	2.62	.34	91
On Miner	7	2.15	.32	81
On Marianna	7	4.12	.61	81
On Peach	15	3.87	.43	107
On Sand cherry	8	4.14	.60	83
Milton:				
On Americana	12	2.19	.27	96
On Miner	7	3.23	.37	106
On Marianna	22	3.74	.32	139
On Peach	19	3.30	.28	142
On Sand cherry	17	3.54	.36	117
Newman:				
On Americana	15	2.49	.30	99
On Miner	10	3.31	.37	109
On Marianna	16	2.67	.31	103
On Peach	21	2.94	.29	120
On Sand cherry	16	3.34	.37	107

SUMMARY AS REGARDS VARIETIES PROPAGATED

Description	Average number of trees	Average height feet	Average diameter inches	Ratio of height to diameter
Stoddard	13.6	3.00	.32	111
Chabot	11.4	3.29	.43	92
Milton	15.4	3.30	.32	125
Newman	15.6	2.93	.32	112

SUMMARY AS REGARDS STOCKS USED

Americana	14.25	2.41	.31	93
Miner	8.25	2.78	.34	98
Marianna	15.75	3.31	.35	113
Peach	17.00	3.25	.32	122
Sand cherry	14.75	3.59	.40	108

The summaries in the foregoing tabulation are of principal interest. As regards the varieties propagated in this experiment it will be seen that there is very little difference. Chabot shows a lower number of trees living than any of the other varieties, but these trees

are very strong and sturdy, as shown by the low ratio of height to diameter. Both these things seem to be characteristic of the variety whenever propagated by grafting.

As regards stocks used, there are some interesting observations to be made. Miner gave distinctly poor results, showing only an average of eight and one-fourth trees living out of every thirty grafts set. The peach stocks gave unusually good results in this respect. The most remarkable fact of the entire year's experiment, however,—namely, the large size and extra thrift of the trees on Sand cherry roots,—shows also in the figures in the summary.

The most interesting feature of this year's propagations has been the strikingly fine showing of the Sand cherry stocks. The Sand cherry (*Prunus pumila besseyi*) is a dwarf shrub or bush native to Kansas, Nebraska, South Dakota, and nearby states. It has been much used in Iowa, Minnesota and the Dakotas as a stock for native plums, the point usually urged in its favor being that it is extremely hardy. Trees propagated on this stock are dwarfed when grown in the orchard; but in our experiments thus far this dwarfing influence has been manifestly absent in the nursery. Instead of being dwarfed, the trees on this stock outgrew all the others. An examination of the photographs reproduced in plates 000 and 000 will show somewhat how strong and heavy were the trees of these lots, grown on Sand cherry.

III. CHARACTER OF ROOT SYSTEMS

In handling these various lots of plum trees from the nursery no one could help being struck by the differences in the root systems supplied by different kinds of stocks. Inasmuch as the root system of nursery trees is looked upon as being of as much importance as the top, these differences become of special interest. There has been a great deal of discussion in horticultural circles as to what constitutes a proper root system for a nursery tree. Some tree planters demand a large quantity of fine, fibrous roots; others demand long, straight tap roots; while still another man wants long, strong, horizontal side roots and cares very little for fibrous roots.

The question of what is really the best has never been settled, and probably never will be. The writer believes that too much stress has usually been laid on the value of fibrous roots. It is well known that these are usually dried out before the trees are planted. They are all dead when they go into the ground. It is hard to see how they can be of any use. Every tree has to put out a new set of feeding rootlets after it is transplanted, and it seems a waste of time trying to save those originally formed in the nursery.

As far as the writer has any opinion based upon experience in this matter, it is that freshness and vigor constitute the chief desiderata in the roots of a nursery tree. That stock which will give the strongest and most vigorous growth in the nursery is, therefore, looked upon as being the best. Nevertheless, even in this view of the case, the differences in the character of the root systems, due to the differences in the nature of the stocks used, is of interest and practical importance.

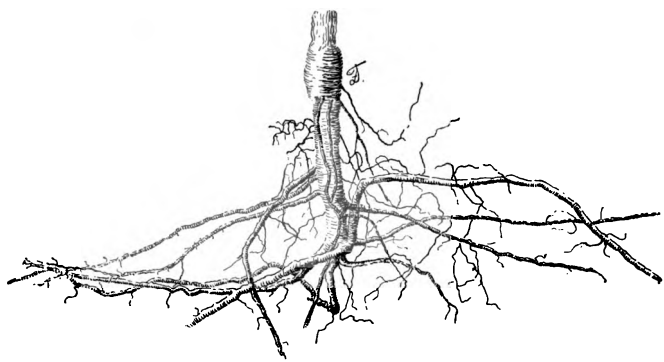
ROOT SYSTEM FROM AMERICANA STOCK

Americana stocks.—Trees propagated on Americana stocks show fairly vigorous roots. The root system is seldom or never symmetrical; it is usually turned strongly to one side. The tap root is oblique. The main lateral roots are strong, but unequally disposed about the center, and there are few fine, fibrous roots. The entire root system is rather small, but vigorous and hardy. The union with most plums, especially Americana varieties, is excellent.

Miner stocks.—We have used these only for a single year, and, as elsewhere mentioned, have found them unsatisfactory. The root system is weak in every respect. There are few roots of any kind, no tap root is formed, and the lateral branches are scattering and irregular. There are no fibrous roots. All these points can be most readily seen by examining the figures given herewith, which are drawn from photographs.

ROOT SYSTEM FROM MINER STOCK

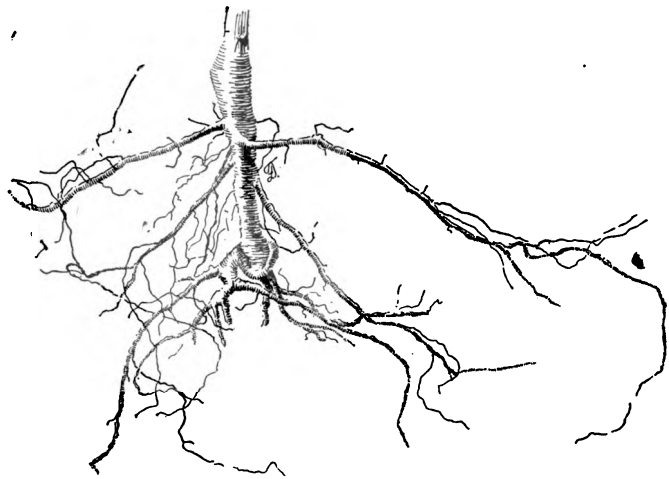
Marianna stocks.—On the whole these seem to have given the best general satisfaction throughout the course of our experiments. The roots are nearly always abundant and vigorous. No distinct tap-root is formed, although sometimes in loose soils there is a tendency for the



ROOT SYSTEM FROM MARIANNA STOCK

root to strike downward to some extent. The lateral roots are long, strong and vigorous, bracing the tree thoroughly. The fibrous roots are few. The union with most varieties is excellent.

Peach stocks.—These furnish fairly good root systems for nursery trees of most varieties of plum. The roots seem to grow well, especially in light, sandy soils. A considerable tap root is usually formed, which is very much twisted. A fair number of horizontal roots are



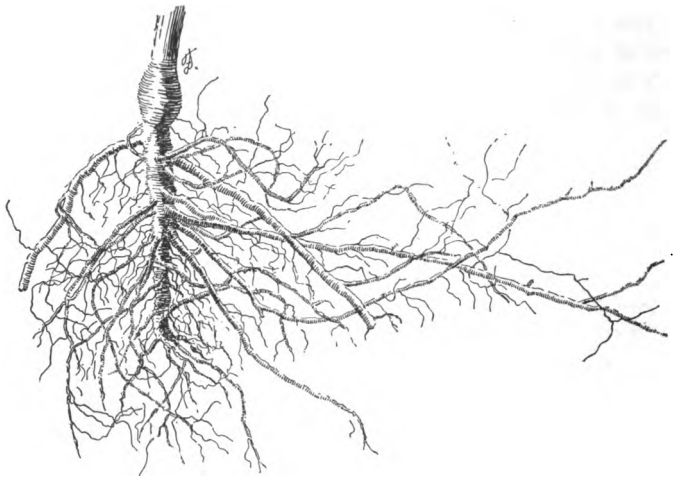
ROOT SYSTEM FROM PEACH STOCK

usually developed, coming out at all points along the original stock. There are few fibrous roots. The union is not generally good. In many trees which make a fair growth during the first year in the nursery the union is so poor that it will break out while the tree is being handled in transplanting.

Sand cherry stocks.—We have used these only one year, but have found them to give remarkably fine root systems. A strong, straight tap root is usually formed, and the secondary roots set out from this in large numbers and on all sides, usually tending downwards at an angle of 40 to 50 degrees with the axis of the stock. There is nearly always a heavy mass of fine fibrous roots. The union with cions of most varieties is good, although usually marked with considerable swelling.

The figures shown herewith will give a better idea of the general character of the root systems than these brief descriptive notes. They are taken directly from photographs, and the photographs are made from typical specimens, and are all drawn to the same scale. In every case the variety growing on these roots was the same, namely, Chabot.

Aside from any of the peculiar influences which the stock may exert on the tree itself, the difference in the root system would cer-



ROOT SYSTEM FROM SAND CHERRY STOCK

tainly influence many men who buy nursery trees or who propagate for themselves. If a man feels justified in laying chief stress on the character of the roots when he buys or propagates a tree, a study of these data will doubtless prove an advantage to him.

IV. ORCHARD CHARACTERS

As these trees grow in the orchard they manifest certain differences also which seem due to the influence of the different stocks on which they were propagated. Some reference was made to this matter in our last report.[1] The curious facts there recorded have been emphasized rather than obliterated by another year's growth of the trees.

The most important observations are to be made in the rows of Milton trees, four representative specimens of which are shown in the accompanying engravings. On Americana stocks the trees are moderately spreading; on Wayland stocks they are distinctly upright; on Marianna stocks they are remarkably low and wide spreading, almost weeping; while on peach stocks they are practically all dead. The most curious contrast exists between the adjacent rows on Wayland and on Marianna roots respectively. A stranger seeing these would hardly believe the trees were of the same variety, though there is not the slightest possibility of mixture. The foliage is much darker on the Marianna-rooted rows, and the twigs are red, while on Wayland or Americana roots, the twigs are green.

The trees on Americana and on Wayland roots bore a considerable crop of fruit in 1902; those on Marianna set no fruit.

[1] Vt. Sta. Rpt. 14, p. 266, (1901).

V. SUMMARY FOR THREE YEARS

The experiments of three years have now been reported. The work has been along much the same lines year by year, so that a general summary of the results to date is easily made.

The varieties propagated have remained practically unchanged during the three years' work, and three of the various kinds of stocks have been used throughout. Omitting Bavay, of the Domestica group, and omitting also those stocks which have not been used in all experments, the three-year averages for the remaining four varieties and three kinds of stocks are summarized in the following table:

GENERAL SUMMARY FOR THREE YEARS, AS TO VARIETIES

Description	Average number of trees	Average height feet	Average diameter inches	Ratio of diameter to height
Stoddard	12 95	2.45	.27	109
Chabot	9.88	3.77	.45	101
Milton	13.88	3.39	.32	127
Newman	13.78	3.42	.35	117

GENERAL SUMMARY FOR THREE YEARS, AS TO STOCKS

Americana	13.88	2.79	.34	98
Marianna	9.78	3.33	.35	114
Peach	13 20	2.92	.33	106

The figures show that Stoddard, a representative Americana, makes a comparatively small growth during the first year in the nursery, while Chabot, of the Japanese group, makes a strong and stocky growth. Chabot, however, nearly always gives a lower percentage of trees from a given number of grafts than any other variety in the experiment.

As regards stocks, the figures suggest that Americana roots unite readily with plums of the various types here represented, and that they give comparatively stout and stocky trees, which, however, are measurably dwarfed during the first year in the nursery. We may add that our experience shows that this dwarfing influence continues to be shown to a marked degree after the trees are planted into the orchard. Marianna stocks have given, in the general result, large, tall, sound trees; but the percentage of grafts which have grown is unaccountably small. The average percentage stand on Marianna stocks for three years has been 32, against 46 on Americana and 44 on peach.

It must be understood, of course, that we are now dealing with a set of averages,—a summary of three other summaries, which is too highly sublimated to contain all the facts. Individual cases formed

striking exceptions to the generalizations here recorded. The first year we were fortunate in getting a remarkably fine strong lot of Americana stocks, and these naturally gave excellent results. The next year the Americana stocks were not so good, and the Wayland stocks were better; while for our last year's work we had an unusually fine lot of Sand cherry stocks. The actual quality and vigor of the stock often exerts a greater influence than its botanical name.

A REVIEW OF THE AMERICANA PLUMS

The aboriginal plums which grow wild on the North American continent have come more quickly into cultivation probably than any wild fruits ever did before; and at the present time they exercise a greater influence on the refined horticulture of the country than any other fruits of recent domestication. There are numbers of native species, but by all means the most important one is the western American plum, *Prunus americana*. There are several secondary groups closely related to the dominant type of *Prunus americana*, and all of them furnishing plums of enough promise to have been propagated and named. It will be desirable in reviewing these plums to take first a brief survey of the original wild types.

The Americana group proper is central in the Mississippi valley, from St. Paul to St. Louis, but spreads over nearly the whole of the great Mississippi basin, from the Canada line and above, nearly to the Gulf of Mexico. The tree is slow growing, very hardy, with coarse, rough, strongly double-serrate leaves, and with abundant red or yellow fruit of moderate size and rich flavor, having, however, usually a very tough astringent skin.

The Nigra group furnishes the most important and distinct offshoot from the Americana group. Geographically it runs further northward and eastward. It differs *more or less*,—often less rather than more,—from the typical Americana plums in having darker bark and foliage, with glandular petioles, and earlier, darker, sparser fruit.

The Miner group is of considerable importance pomologically, though from the botanical standpoint it is very difficult to distinguish it from *Prunus americana*. It has furnished various good cultivated varieties, like Miner and Surprise, which have foliage smoother than in *P. americana*, and fruits with thinner skins, which have a peculiar crisp crackling texture.

This group was unfortunate in its botanical christening, having been described by Professor Bailey as an offshoot from the Hortulana or Wildgoose type. As a matter of fact it is only distantly related to the Wildgoose type if at all, while it is so clearly akin to the Ameri-

cana type as to be very difficult of separation.[1] The name which the group now bears should, therefore, in the view of the writer, be revised so as to show properly the natural affinities of these types. The following new combination of old names is proposed to meet these requirements:

Prunus americana mineri, the Miner type of plums formerly known as *Prunus hortulana* Bailey.

The Woolly-leaf plums form a southern extension of the Americana species. They are characterized by pubescent twigs and leaves. Only a few cultivated varieties of quite secondary importance have arisen from this group.[2]

Reviewing these types under their botanical names, with the principal synonymy, they may be arranged as follows:

PRUNUS AMERICANA Marsh., Arb. Am., 111 (1785).

PRUNUS AMERICANA NIGRA Waugh, Vt. Sta. Bul. 53, 58 (1896).

P. nigra Ait., Hort. Kew, ed. 1, II, 165 (1789).

P. americana Torr. and Gray, Fl. N. A. I, 407 (1840) in part.

PRUNUS AMERICANA MINERI Waugh, supra.

P. hortulana mineri Bailey, Cornell Sta. Bul. 38, 23 (1892).

PRUNUS AMERICANA MOLLIS Torr. and Gray, Fl. N. A., I, 407 (1840).

Prunus americana lanata Sudw., Nom. Arb. Fl. U. S., 237 (1897).

These matters of nomenclature and of botanical classification, however, are of only minor interest to the pomologist. He desires chiefly to know about the cultivated varieties, their qualities and their value to the orchard planter. On this side our current knowledge of these several groups of plums certainly leaves much to be desired. The most of the plums originating from these types and now in cultivation have been very recently collected from the fields. Only a small minority of them represent any effort at the breeding of improved stock. The majority of them stand only for a crude attempt at selection.

It is natural and necessary that, at the outset, we should have been interested most in the acquirement of new varieties. Various enthusiastic plum growers have accordingly made large collections, numbering many hundreds of varieties, brought from all parts of the United States and Canada where an active interest has been taken in the native plums. It is quite time now, it seems to us, that our efforts

[1] The writer formerly supposed the Miner plums to be hybrids between *Prunus americana* and *P. hortulana* (See Garden and Forest, 10, p. 340, 1897), but he is now inclined to relinquish that view. While such hybridizations probably have occurred, the Miner group for the greater part seems to be merely a slight departure from the dominant type of the Americana group.

[2] For more general discussion of the relationships of these groups see Vt. Sta. Rpt. 12, p. 231 (1899).

should pass from the collection of varieties to the selection of varieties.[1]

There are at the present time approximately 200 varieties in these closely related groups, named, recorded and propagated. Many of them are so conspicuously inferior to the others that there need be no hesitation in discarding them. Indeed it is a duty which every pomologist owes to the public and to posterity to relieve our orchards and nurseries of these varieties just as soon as possible. Then there are dozens of varieties which, though not so manifestly below standard, are so much alike one another that many of them could advantageously be spared. In fact out of the 150 named varieties, more or less, in the Americana group proper, there are probably not two dozen which can be recognized with certainty by the best plum expert living.

It becomes highly desirable, therefore, that the lists of varieties should be weeded out. But this is a very delicate and almost impossible task. The greatest barrier to the progress of such work lies in the fact that varieties behave so very differently in different localities. Hawkeye, which is one of our best varieties in Vermont and this vicinity generally, is discarded by the fruit growers of Wisconsin and Iowa because its fruit there proves coarse and inferior in quality, while further south the variety is almost worthless. Instances of this sort might be multiplied indefinitely. For several years, however, the writer has been hoping to see a start made in the direction of revision; and now, with due apologies, and with full acknowledgment of the difficulties in the way, he offers the following provisional separation of varieties into three classes,—(1) those of proved value, which ought to be retained, (2) those of doubtful value, requiring further test, (3) culls, those which, either because of real inferiority, or because they duplicate better known varieties, should be discarded.

This list has been so carefully made, and under the stress of so manifest a need, that the writer hopes it will in most points meet the endorsement of plum specialists everywhere. Regarding many of the varieties there will certainly be no disagreement. The list has already been submitted to various experts, so that the judgments here expressed do not rest on the opinion of any one man.

Naturally most of the very new varieties have to be placed in List II for further test, or else omitted altogether. Unless there is

[1] The epigram is not original with the present writer, but was used by the great french pomologist, Leroy, nearly a quarter of a century ago. In the introduction to his volume on peaches, he said: "Quand, on songe qu'une telle augmentation, qui affecte tous nos genres fruitiers, s'est produite en un quart de siecle a piene, et ne semble pas prete a s'arreter, it est tres-permis de la deplorer et d'engager les pepinieristes a passer desormais, serieusement, de la *collection* a la *selection*."

some reason to believe that they have merit the latter alternative has usually been followed. This is because it is desired to make these judgments positive rather than negative. Some comparatively old varieties have been altogether omitted for the same reason, that is because they were not well enough known to the writer so that he could positively place them in any of the three lists.

LIST I. STANDARD VARIETIES

Those which are thought to have positive merit for some section of the country.

AMERICANA GROUP

Advance
American Eagle
Bixby
Blackhawk
Brittlewood
DeSoto
Etta
Free Silver (Terry)
Gaylord
Hanson
Hawkeye
Holt
Hunt
Kickapoo
Kieth
Louisa
Mollie
Pearl
Pilot
Quaker
Queen (Golden Queen)
Smith
Snooks
Stoddard
U. S.
Wolf
Wyant

NIGRA GROUP

Aitkin
Cheney
Smith Red

MINER GROUP

Forest Rose

LIST II. DOUBTFUL VARIETIES

Those which should be given further test before being either discarded or added to the standard list.

AMERICANA GROUP

Atkins
Baraboo
Budd
Bender
Bryan
Champion
Comfort
Cottrell
Dunlap
Haag
Hammer
Hart (Hart's DeSoto)
Hoskins
Isabella
Jessie
Lillie
Lottie
Marcellus
Nellie Blanche
New Ulm
Ocheeda
Rockford
Sada
Silas Wilson
Stella

NIGRA GROUP

Odegard

MINER GROUP

Maquoketa
Oren
Surprise

LIST III. REJECTED VARIETIES

Those which are in themselves comparatively valueless, or which needlessly duplicate better known varieties.

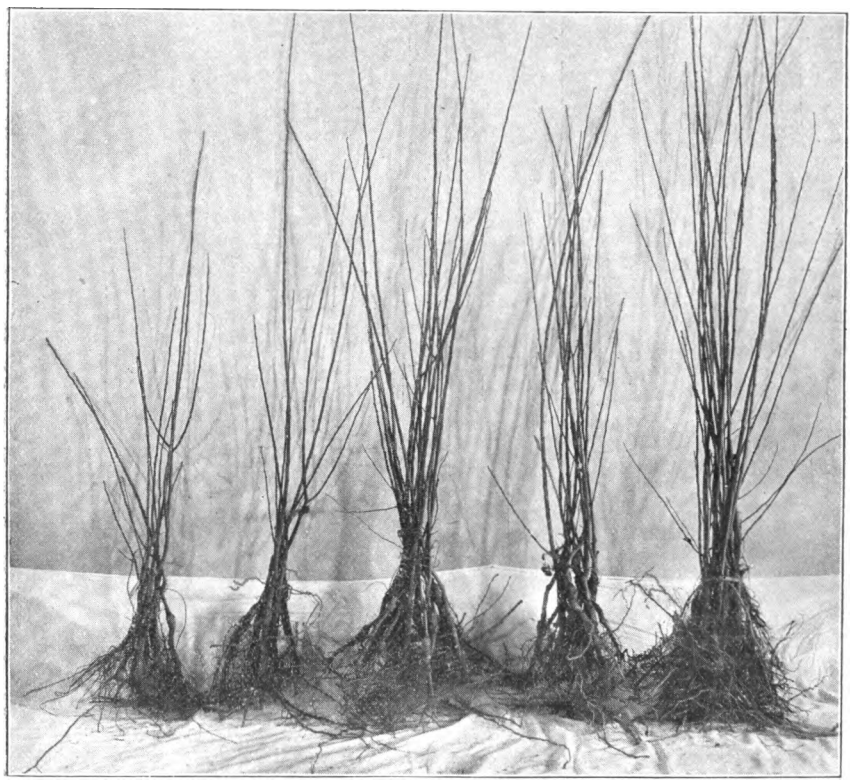
AMERICANA GROUP

Allen's Yellow
Apricot
Bean
Brainerd
Bursoto
California
Carver
Cherokee
Chippeway
City
Colorado (Colorado Queen)
Comptine
Cook's Choice
Deep Creek
Dennis
Des Moines
Eldora
Forest Garden
Galena
Gale
Gold (of Terry)
Gold Colored
Grace
Hardwick
Hiawatha
Hilltop
Honey
Ida
Iona
Irene
Ironclad
Isaac
Ivason
Joe Hooker
Jones
Jones Late
Kampeska
Kopp
Knudson
Labert
Late Rollingstone
Le Duc
Leonard
Lockey
Lottie
Manitoba
Mankato
Marcus
Marion
Minnetonka
Monon
Moon
Muncy
Mussey
Nellie
Newton Egg
North Carolina
North Star
Noyes
Old Gold
Peffer
Penning
Plunk
Purple Yosemite
Quality
Rareripe
Reel
Rocky Mountain
Sloe
Speer
Truro
Van Deman
Vermillion
Warren
Wildrose
Winnebago
Wood
Yellow Sweet
Yellow Yosemite

NIGRA GROUP

August
Crimson
Harrison (Harrison's Peach)
Itaska
Oxford
Seper (Seper's Peach)
Wazata
Williams

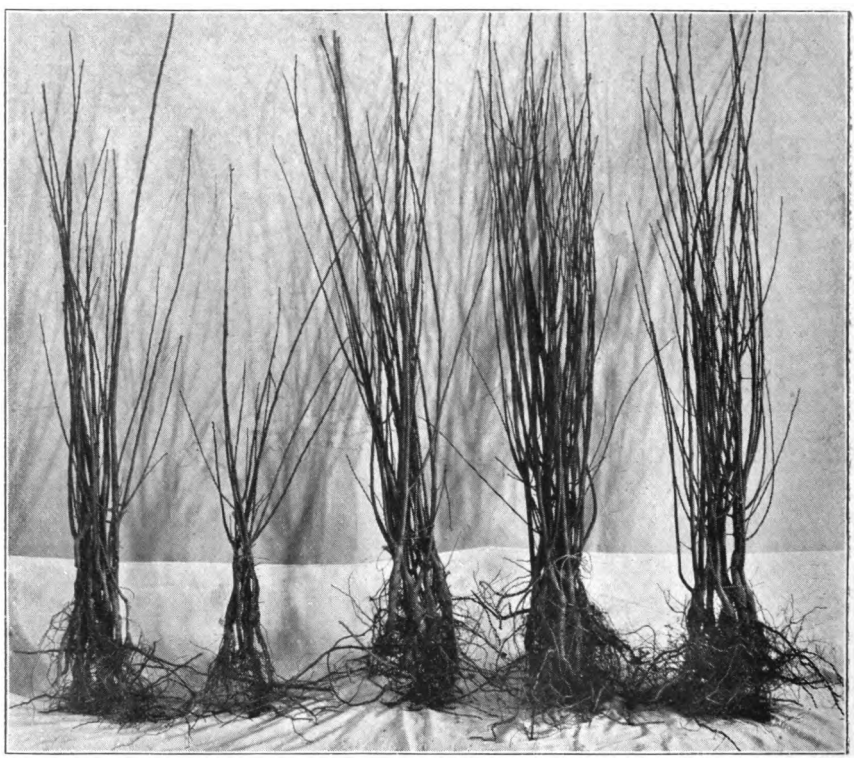
STODDARD TREES ON DIFFERENT STOCKS



AMERICANA | MINER | MARIANNA | PEACH | SAND CHERRY

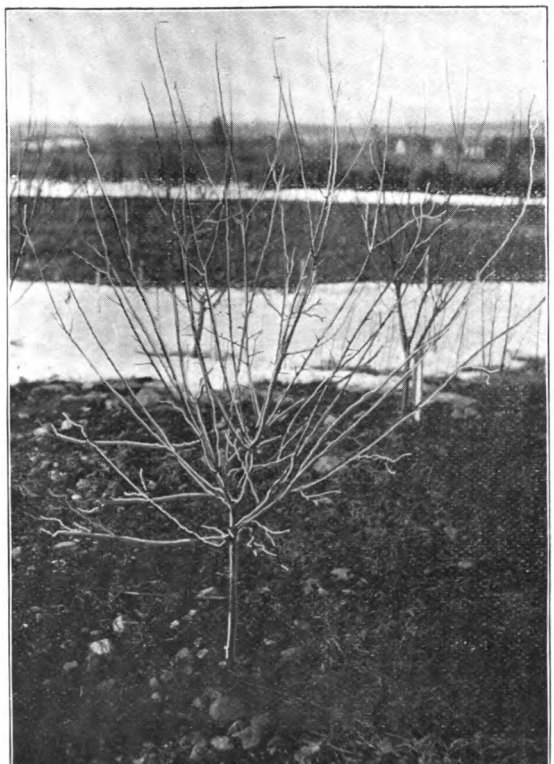
(See pages 251-258.)

CHABOT TREES ON DIFFERENT STOCKS

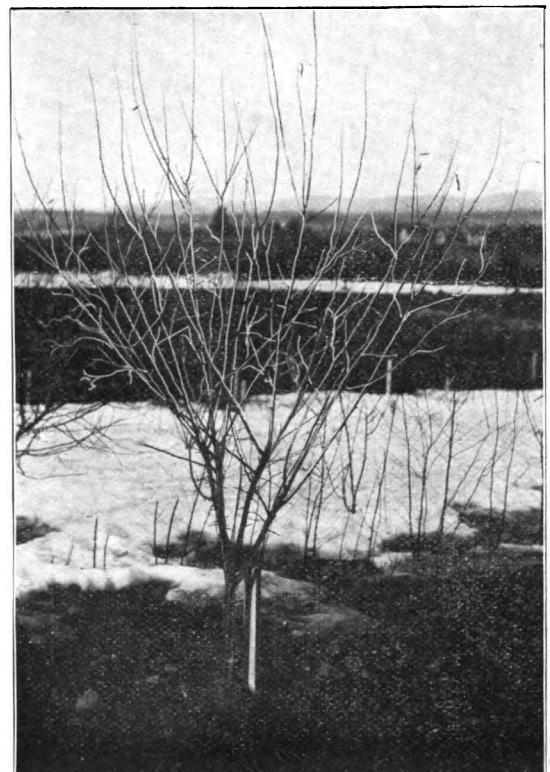


AMERICANA MINER | MARIANNA | PEACH | SAND CHERRY

(See pages 251-258.)

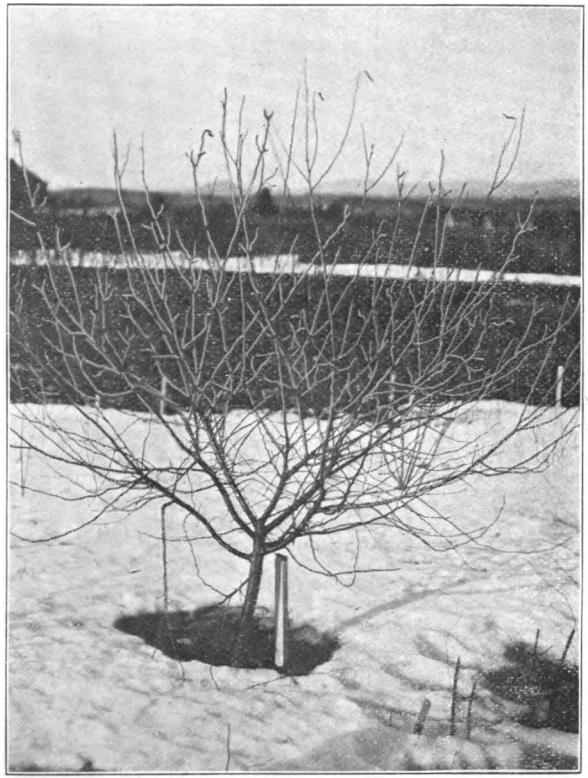


MILTON ON AMERICANA



MILTON ON WAYLAND

(See pages 251-258.)



MILTON ON MARIANNA

MILTON ON PEACH

(See pages 251-258.)

MINER GROUP

Clinton	Iris
Crescent City	Miner
Decker	Nebraska
Esther	Rachel
Idall	Wier (Wier's Large Red)
Indiana (Indiana Red)	Wilder

THE JAPANESE-HYBRID GROUPS OF PLUMS

I. THE SITUATION IN GENERAL

In the various contributions which this station has furnished to the literature of the hybrid plums, the observation has been repeatedly made that these hybrids are of such a character that they may be classified into a comparatively small number of groups. In particular, all the hybrids originating from the crossing of two specific parents are usually so much alike as to present a readily recognized type. This observation simply tends to verify one of the long-recognized laws of hybridity. It is of chief interest to the pomologist, however, in offering a basis for the classification of varieties. There are so many different kinds of plums named, propagated and planted that any practical method of grouping together those of similar characters comes as a genuine relief to the man who is compelled to keep up an acquaintance with all of them.

Among those generally accepted species of plums which have become the parents of our hybrid varieties, the Japanese species (*Prunus triflora*) has been much the most prolific. Out of 18 hybrids of known parentage described in a former report,[1] 12 had Japanese blood in them.[1] These hybrids, further, seem to be of superior value for orchard planting, so that if one could make a count of trees now growing in orchard and nursery, instead of names appearing in the books, he would probably find ninety-nine percent of the hybrids of Japanese parentage.

In our last report a classification of these hybrid plums was begun. The Gonzales group was defined, and the botanical name, *Prunus hortulana robusta*, was applied to it.[1] This group comprises those

[1] Vt. Sta. Rpt. 12, p. 219 (1899).

[1] It will doubtless occur to the reader that no plum has any "blood" in its veins. This form of expression, however, has become so well established in speaking of questions of parentage, inheritance, etc., that one can hardly avoid using it. It is a mere form of speech, and not to be interpreted too literally. When closely examined it will be seen to be no more figurative nor further from the facts when used of plums than when used of rabbits, or Poland china swine.

[1] Vt. Sta. Rpt. 14, p. 276 (1901).

varieties which are hybrids of the Japanese plum with the varieties either of the Wildgoose or the Chicasaw group. The type here presented is more closely related to the Wildgoose type than to any other previously described, and this affinity is suggested in the form of the botanical name.

In the two types now about to be described, however, the resemblance is stronger on the side of the Japanese parents, so that it seems best to refer them to this species, *Prunus triflora.*

II. THE OMAHA GROUP

The Japanese plums hybridize with the Americana plums (*Prunus americana*) with considerable difficulty. Only a few authentic hybrids have been produced, and these for the most part have not yet been publicly distributed. The writer, however, has had an opportunity to study many of the undistributed varieties, especially from the productions of Mr. Theo. Williams, of Nebraska, and of Mr. Luther Burbank of California.

It appears to be the case that when the two species in question are crossed the offspring sometimes very closely resembles one of the parents, especially the American parent, *Prunus americana.* The varieties Bursoto[1] and Ames[2] are of this class. In other cases it appears that the two parent species blend much more fully as in the variety Omaha.[3] This is the only variety of this sort now described; but several other very similiar hybrids have been examined, some of which will probably soon be brought into the nursery trade. The type promises to be one of the most valuable from the standpoint of the commercial fruit grower of any yet introduced. The following technical name and description for this type are therefore offered for record:

Prunus triflora rustica (new name).—Tree very vigorous, generally upright, branches very strong and straight or very slightly zigzagged during the first year; bark dark reddish brown with heavy wavy grayish markings and prominent reddish lenticels, considerably Americana-like; spurs less thorny than in *Prunus americana* but otherwise similar; foliage between *P. americana* and *P. triflora,* intermediate in all respects; fruit larger than in *P. americana,* usually somewhat cordate or pointed, with tough rather thick skin, and large dots suggesting *P. americana;* flesh juicy, somewhat like *P. hortulana;* stone

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[1] Bursoto. See Vt. Sta. Bul. 67, p. 8 (1898).

[2] Ames. See Vt. Sta. Rpt. 12, p. 220 (1899). Also Iowa Sta. Bul. 46, p 261 (1900).

[3] Omaha. See Vt. Sta. Rpt. 14, p. 272 (1901)

usually Americana-like, cling, rather large. The general habit of growth and habit of tree are suggestive of *P. triflora*. Made up of hybrids between *P. triflora* and *P. americana*. The variety Omaha may be taken as the type.

III. THE WICKSON GROUP

One of the most striking lines of hybrids yet produced is that arising from a combination of the Japanese plum with the Apricot or Simon plum, *Prunus simonii*. Wickson is the best known variety of this parentage; but Allfruit, Bartlett, Chalco, Climax, Late Conical, Maynard, President and others have the same origin. Curiously these are all the productions of one man, Mr. Luther Burbank. Several of these, notably Wickson, are already widely planted in orchards. The horticultural importance of the type will certainly be denied by no one. The botanical distinctness, homogeneity, and stability of the group may be open to greater question; but the conditions nevertheless seem to warrant the following technical name and description:

Prunus triflora recta (new name). Tree tall, very upright, with rather light grayish-brown bark on old wood, young wood characteristically bright green; leaves medium size or smaller, seldom very large, oval or long oval, tapering at both ends, smooth and shiny above, bright gray-green underneath, on short obscurely glandular petioles, and with finely crenulate margins; flowers medium or small, solitary or in twos or threes, appearing very early; fruit various, usually dark dull red when fully ripe, firm and meaty, of good quality. Made up of hybrids between *Prunus triflora* and *P. simonii*. The variety Wickson is best known, and is especially typical as regards fruit. The variety Bartlett is more nearly typical as respects tree and foliage.

REPORT OF THE CHEMISTS

C. H. JONES and B. O. WHITE

The work of the chemists for the past year has been mainly along the usual routine lines. It includes the analyses of commercial fertilizers collected in 1902 and published in bulletins 92 and 93; analyses of commercial feeding stuffs, bulletins 91 and 97; and the analytical work incident to the feeding experiments reported later in this volume under the head of "Dairy Feeding," including the analyses of coarse and fine feeds, as well as of milk and butter. Some work was also done for the Association of official agricultural chemists. The chemical work connected with four dietary studies, recently carried on in Vermont, in co-operation with the nutrition investigations conducted by the Office of Experiment Stations, was likewise done in this laboratory. There have also been examined nearly 100 samples of miscellaneous materials sent in by residents of the state, exclusive of over 500 samples of milk. A large amount of work has likewise been done in studying the chemistry of the maple sap flow, which will contribute to bulletins shortly to be published.

These considerations make it clear that the brief "report" presented below is in no way a measure of the activities of the department.

MISCELLANEOUS ANALYSES

Section 263 of the Vermont Statutes requires the station to analyze free of charge miscellaneous materials of an agricultural nature for residents of the state. Those deemed of sufficient interest to place on permanent record are here recorded.

MATERIALS FURNISHING NITROGEN

Material	From	Percent of nitrogen
Nitrate of soda	Piermont,	15.96
Nitrate of soda	Wilmington,	15.86
Sulphate of ammonia	Williamsville,	13.88

The nitrates are of good quality but the sulphate of ammonia is of low grade.

MATERIALS FURNISHING NITROGEN AND PHOSPHORIC ACID

Material	From	Percent of nitrogen	Percent of phosphoric acid
Raw bone meal	Hyde Park,	3.61	17.22
Ground bone	Danville,	2.53	25.06
Ground bone	St. Johnsbury,	4.35	22.22
Ground bone	Barre,	2.81	25.14
Ground bone	Williamsville,	1.53	30.56
"Increase" bone dust	East Barnet,	2.53	13.10
Dry ground fish	Woodstock,	8.61	6.25
Fish scrap	Williamsville,	8.35	7.04

The samples of ground bone show marked variation in nitrogen and phosphoric acid content. Some are steamed bone.

The two samples of fish are up to the average of materials of their kind.

MATERIALS FURNISHING AVAILABLE PHOSPHORIC ACID

Material	From	Phosphoric acid				
		Soluble %	Reverted %	Insoluble %	Total %	Available %
Acid phosphate	Vergennes	10.53	4.56	2.67	17.76	15.09
" "	Woodstock	8.75	4.56	2.16	15.47	13.31
" "	Williamsville	9.80	3.26	2.00	15.06	13.06

The available phosphoric acid varies from 13.06 to 15.09 percent. This is an improvement over the grade of the goods found on the market in 1901.

MATERIALS FURNISHING POTASH

Material	From	Percent of potash
Muriate of potash	Piermont,	49.50
Muriate of potash	Woodstock,	49.73
Sulphate of potash	Woodstock,	48.10
Sulphate of potash	Williamsville,	49.00

With the possible exception of the sulphate of potash the samples are of standard quality.

WOOD ASHES

From	Soluble potash %	Insoluble potash %	Total potash %	Total phosphoric acid %	Calcium oxide %	Insoluble matter %
J. H. Bates, Proctorsville	2.85	0.81	3.66	1.47	37.40	7.29
L. H. Felton Highgate Springs	4.94	1.66	6.60	1.40	36.74	2.83
" " " "	2.16	1.82	3.98	1.21	39.34	2.18
E. O. Lee, Vernon	5.00	0.88	5.88	1.47	40.86	6.63
F. V. Farr, Westminster Station	0.99	0.41	1.40	0.59	33.79	3.82

Three of these samples are of poor quality as regards their potash content. The soluble potash varies from 0.99 to 5.00 percent. The goods which the last sample represents had evidently been leached. As analyzed it contained over 30 percent water. Owing to the variable character of wood ashes parties will do well before purchasing to submit samples to the station for analysis.

FERTILIZERS AND HOME MIXTURES

From	Nitrogen %	Soluble phosphoric acid %	Reverted phosphoric acid %	Insoluble phosphoric acid %	Total phosphoric acid %	Available phosphoric acid %	Potash %
Morrison farm, Barre, Vt	3.79	3 20	2.04	1.22	6.46	5.24	7.85
F. A. Kezer, Fletcher	0.77	0.37	6.00	3.07	9.44	6.37	1.44
S. J. Hastings, Passumpsic	1.82	0.00	1.17	2.15	3.32	1.17	1.44
H. Davis, Brownington	2.72	0.51	5.78	1.27	7.56	6.29	10.57

The last two samples are reported to be home mixtures. For information regarding home mixing the reader is referred to bulletin 93, which will be sent on application.

MUCK

From	In original substance				In dry matter		
	Water %	Ash %	Organic and volatile matter %	Nitrogen %	Ash %	Organic and volatile matter %	Nitrogen %
H. F. Emery, Thetford Center	33.73	9.57	56.70	1.86	14.44	85.56	2.86
B. W. Pennock, Rutland	69.38	11.[illegible]7	18.75	0.43	38.78	61.22	1.40
L. A. Drew, Burlington	83.37	0.59	16.04	0.16	3.56	96.44	0.90
" " "	77.42	11.29	11.29	0.27	50.00	50.00	1.21
L. W. Barton, Ludlow	88.15	0.32	11.53	---	2.70	97.30	---

Muck and peat, aside from their value as absorbents and fertilizers, may serve for fuel purposes. Samples Nos. 3 and 5 are apparently well adapted to such use owing to the small amount of ash and the large amount of organic and volatile matter present in the dry matter. In the original deposit these samples are seen to contain large percentages of water which must of course be removed by drainage, drying and, possibly, pressing.

FEEDS

Material	From	Water %	Crude ash %	Crude protein %	Crude fiber %	Nitrogen-free extract %	Ether extract %
Cocoanut meal	R. H. Gale, Stowe	13.60	6.43	20.63	10.60	40.81	7.93
Fowl seed	E. O. Roy, West Barnet	7.25	5.25	18.22	8.94	31.69	28.65

The sample of cocoanut meal contains nitrogen 3.31 percent, phosphoric acid 1.17 percent and potash 2.20 percent. If the price is right it is apparently a desirable feed. The last sample is said to be a mixture of wild turnip and kale seed. It should be fed with caution owing to the large amount of ether extract or fat present.

DAIRY FEEDING

J. L. HILLS

There has been no material change in the aim or nature of the investigations in dairying carried out during the past year as compared with those hitherto reported. Extensive feeding trials are an annual feature, trials which are designed to investigate methods of experimentation as well as to furnish data concerning food values; herd records are maintained and reviewed; the effect of sundry feeds on butter quality is studied; and various minor matters are from time to time examined.

The experiments completed and written up since the fourteenth report was issued are discussed under the following headings:

Feeding trials with cows.

- I Introduction.
- II Statement of methods and details of conduct of the feeding experiments.
- III How much grain can be fed with profit to dairy cows?
- IV The feeding value of malt sprouts.
- V The feeding value of dried brewers' grains.
- VI The feeding value of King gluten meals of relatively low and of high protein contents.
- VII The feeding value of apple pomace.
- VIII Experimental error.
- IX Summary.

A comparison of feeding trial methods.

The effect of feed on the quality of butter.

Records of the station herd for 1900-01 and for 1901-02.

A comparison of score card judgments and of milk and butter records.

The change from barn to pasture.

Appendix containing condensed data pertaining to the article on "Feeding trials with cows."

The article comparing score card judgments and actual performance at the milk pail is based on a thesis presented by Mr. R. R. Strait in fulfillment of a requirement for graduation from the Agricultural Department of the University of Vermont.

FEEDING TRIALS WITH COWS

This article is summarized at its close, on pages 316 to 318. The results of the trials are concisely stated therein and cross references are given.

I. INTRODUCTION

The general line of feeding tests begun five years ago has been followed in the work of the past season. Some of the tests are repetitions of those made last year and discussed in the fourteenth report, it being our settled policy to make at least two years' feeding trials of all important matters. Some stress has been laid upon the comparison of the relative food values of sundry rations, but not to the exclusion of the consideration of important fundamentals in dairy stock feeding. Indeed if anything the latter notion has held precedence over the former.

The equipment of the station is in many ways well adapted to this line of work. The large size of its herd in particular permits wide range in choice of animals, much repetition of work, and the conduct of a relatively large number of trials at one time.

The feeding experiments of the past winter were designed to aid in the answering of the following questions:

(*a*) What is the effect on the quantity and quality of milk and on the economy of production, of low, of medium and of heavy grain feeding? What is the limit of profit in the addition of grain to a ration?

(*b*) What is the feeding value of malt sprouts as compared with a mixture of cottonseed and linseed meals? What is their value as compared with ground oats?

(*c*) What is the feeding value of dried brewers' grains as compared with a mixture of cottonseed and linseed meals?

(*d*) What are the feeding values of two King gluten meals, one relatively high and the other low in protein content? Will the cow agree with the chemist and call the latter inferior to the former?

(*e*) What is the feeding value of apple pomace?

(*f*) What is the extent of the experimental error inherent in feeding trials of the kind now under consideration when the alternation method of measurement is used?

Trials *a*, *e*, and *f* were repetitions of tests made in previous years, trials *b*, *c*, and *d* were new this season.

II. STATEMENT OF METHODS AND DETAILS OF CONDUCT OF THE FEEDING EXPERIMENTS

The records of 56 cows were kept in the five and one-half months duration of the feeding trials. Fifty of these records are deemed safe

to use. But little sickness troubled the conduct of the trials. The results of certain periods with some cows were rendered useless because of temporary illness, of early drying off, or because the animal went off feed. In five of the six cases where records are useless early drying-off is at fault. A few mistakes happened in feeding, vitiating results for several periods, and, in one case, for the entire season. It is not strange that some errors of omission and commission occurred, or that some sickness intervened to affect results in individual cases, in view of the fact that 56 cows were fed for from 84 to 168 days under conditions which involved many, and, often, radical changes in the character or the quantity of their rations.

No seriously disturbing factor common to the entire herd was noted. Malt sprouts (used in mixed feed 4) was poorly relished, lessening the value of results in two experiments. In all other respects the outcome was highly satisfactory.

The 50 cows whose records are available for use were distributed among the several tests as follows:

(*a*) Low, medium and heavy grain feeding	26
(*b*) Malt sprouts and cottonseed and linseed meals	4
(*c*) Dried brewers' grains and cottonseed and linseed meals	1
(*d*) Malt sprouts and ground oats	6
(*e*) Corn silage vs. apple pomace silage	8
(*f*) High and low grade gluten meals	4
(*g*) Experimental error	1
	50

All the cows were not equally well suited to our purposes as regards time of lactation. A long and careful study of previous records —extending over nearly eight years with some animals—of ages, times of calving, flow and quality of milk, times of service, etc., prefaced choice for the various experiments. Preference in selection was on the whole given to the trial of the varying amounts of grain.

DETAILS OF FEEDING

The feeding periods were four weeks long. The first 10 days were always considered preliminary and non-experimental while the last 18 were chosen as the experimental portion. The experimental portions only of the periods are considered in the discussion, and are hereinafter referred to as "the period." The conclusions drawn are based solely upon the results obtained during the 18 day periods. The preliminary portions were considered as preparatory only, as being necessary to get the animal fairly upon and accustomed to its new diet when change

was made therein. For the sake of uniformity and for the purpose of rendering comparisons more strict, the same separations into preliminary and experimental portions were made with the records of those animals which were uniformly fed. Although of but incidental use, full feeding and milk records were kept, samples of fodders and feeds and milk taken, and analyses made, in the same manner and with the same care during the preliminary as during the experimental portions of the periods. All the calculations have been made for the preliminary as well as for the experimental portions. This enables a constant check to be kept upon the progress of the trials and more clearly shows faults if such exist.

The cows were fed twice daily, watered twice, and turned out into the yard twice. The yard exercise varied in duration from 15 to 30 minutes according to the weather. Hay was first fed morning and night; after this was eaten, as much silage was given as the cow would consume; and then the grain was fed. The amount of hay offered each cow was in the main uniform throughout the test. The amount fed naturally was varied between cows according to their ability to consume it. All fodders and feeds were weighed as fed. The uneaten food was weighed back daily and its nature noted.

FEEDING PLAN OF ALL TESTS

The formulas, digestible constituents, etc., of the mixed feeds numbered 1 to 7, and of the grain feeds and by-products from which they were formed, as well as of the roughages used are shown on pages 282-283. It may be said in brief, that Nos. 2 to 4 carried one-third and Nos. 1, 5, 6 and 7 two-thirds parts by weight of bran; and that in the several mixtures the following materials were used as supplements to the bran: No. 1, cottonseed and linseed meals, No. 2, germ oil meal, No. 3, dried brewers' grains, No. 4, malt sprouts, No. 5, ground oats, Nos. 6 and 7, King gluten meal (two grades, one relatively low, the other higher in crude protein).

All the cows received hay in amounts ranging from 12 to 20 pounds daily, and silage (except in trials involving changes in this material) in amounts ranging from 12 to 30 pounds daily.

The changes in daily grain feed were as follows:

(*a*) *Low, medium and high grain feeding;* twelve cows, continuous feeding on either mixed feeds 2 or 3, amounts varying either from 4 to 8, or from 8 to 12 pounds daily; fourteen cows, the same, amounts remaining constant throughout at either 4 or 8 or 12 pounds daily.

(*b*) *Malt sprouts vs. cottonseed and linseed meals* (Nos. 4 and 1); two cows alternating on mixed feeds 1 and 4; one cow, continuous feeding on No. 1; one cow, continuous feeding on No. 4.

(*c*) *Dried brewers' grains vs. cottonseed and linseed meals* (Nos. 3 and 1); one cow, alternately fed mixed feeds 3 and 1.

(*d*) *Malt sprouts vs. ground oats* (Nos. 4 and 5); three cows alternating on mixed feeds 4 and 5; two cows, continuous feeding on No. 5; one cow, continuous feeding on No. 4.

(*e*) *Corn silage or apple pomace silage;* six cows, alternating on the two silages; two cows, continuous feeding on apple pomace silage.

(*f*) *High and lower grade gluten meals;* four cows alternating on mixed feeds Nos. 6 and 7.

(*g*) *Experimental error;* one cow, continuous feeding on mixed feed No. 1. The twenty cows fed continuously in tests (*a*) (*b*) (*d*) and (*e*) furnish data for use under (*g*).

The heifers were fed six pounds of grain daily, the other cows eight pounds daily unless otherwise stated.

Comparisons of the amounts of nutrients eaten by the various cows with the Wolff and the Wolff-Lehmann standards show that while there were wide variations in eating as between the different cows and rations there was generally eaten enough and to spare of each of the ingredients. In fact it may be said in general that the feeding was liberal and equal to the standard needs of cows a hundred pounds or more heavier. In some cases, when the poorer rations were eaten, too little protein was consumed. In most cases, however, the amount of this latter nutrient eaten approximated, and, indeed, often exceeded that called for by the standards. More specific statements touching these comparisons are made in the discussion of each test.

WEIGHTS OF COWS

All of the cows used were weighed during the first three days of the opening period, and on the last three days of all periods. Average weights are shown in table I of the appendix. Half the number gained weight during the winter; nearly a half held their own—with more or less fluctuation—; and four cows lost weight, but not to any serious extent. The causes of variation in live weight are many and obscure, and a survey of the data is not very enlightening. There appear, however, to have been some general tendencies. A lessened live weight followed a shortened grain ration and an increased weight a larger ration nearly three times as often as when the reverse result occurred; but nearly half the time little or no effect on live weight was observed. Uniform feeding on low, medium, or high grain rations kept the animals on the whole at a fairly even live weight. The cows alternating on malt sprouts and ground oats tended to gain in weight on the latter diet, which was much the more readily eaten. Those

fed continuously on ground oats dropped off in weight, while the single animal fed on the cottonseed-linseed ration gained. The cows gained on silage and pomace quite uniformly. They all received the cottonseed-linseed ration. Several of the cows in this trial, however, were within a few months of calving.

BARN TEMPERATURES

The cows were stabled in two portions of the barn structure, the temperatures of which were taken daily at 5 A. M., 12 M., and 6 P. M. The exposed location of the station barn causes considerable fluctuation in the temperature of the cow stables during the winter, notwithstanding the comparatively large number of animals housed therein. Owing to the unusually even temperature throughout the winter, the lack of any long "cold snaps," the warm, early March, and the cold April weather, barn temperatures were more uniform during the trials of the past season than has been the case for many years.

The average barn temperatures, morning, noon and night, during each period, the ranges of variation, and the percent of the entire number of observations within 3° F. of the mean of each period are tabulated in the appendix. Careful comparisons of variations in milk yield with temperature changes which extended over three or more days were made and but a single case of probable relationship was noted. From December 24 to 30 the barn temperatures averaged 5° higher than did the mean of the eighteen days of the period including these dates. The milk flow increased a little more than 3 percent during this holiday time as compared with the yields given before or after the warmer weather. Five-sixths of the cows gave a larger flow than they did in the preceding week, The one-sixth which did not better the yields, either held their own or very slightly lessened it. There was a rise in temperature over normal amounting to 6° F. occurring in late February and early March, but no coincident variation in milk flow was observed. The December increment was much the largest fluctuation which occurred coincidently with temperature change. This increase (3 percent for 6 days) is too small an amount to have any material effect upon the average of results obtained in periods 18 days in length. At most it may have modified results to the extent of 1 percent. Alternation, moreover, negatived even this small plus, since its effect would be felt on both sides in all trials.

A more uniform barn temperature than is attainable under our conditions would have been an advantage; but it is judged from these comparisons, as well as from a large amount of study given to this matter in former years, that temperature variations had little if any

effect on the final results. It should be noted, moreover, that, since all the cows were housed together, these effects, if any, might be expected to be uniformly exerted on all; and that in every trial cows were being alternated on feeds, there being some fed on each ration at all times. It should be remembered also in this connection that all the cows were turned out daily for from 15 to 30 minutes.

PERIODS AND COWS

The following tables show the periods, dates and the cows in use, with the nature of the grain feed eaten during each period. The names which are italicised are those of registered Ayrshires, the small capitals indicate registered Jerseys, while the names given in ordinary type are those of high grade Jerseys.

COWS USED AND NATURE OF GRAIN RATIONS, ETC., FED OR TREATMENT DURING EACH PERIOD

Name	Approximate age Nov. 1	Calved 1901 or 1902	Served 1901 or 1902	Feed	Period numbers I	II	III	IV	V	VI
Low, medium and high grain feeding										
Goldenrod	10	May 7	Oct. 19	No. 2	med.	low	med.	low	med.	----
Buttercup	5	Mch. 19	Farrow	"	low	low	low	low	low	low
Lorna Doone	2	Feb. 24, '02	Farrow	"	----	----	----	med.	low	med.
Kimberley	2	Jan. 27, '02	May 1, '02	"	----	----	----	low	low	low
Viola	5	Dec. 24	Mch. 21, '02	"	----	med.	low	med.	low	med.
Stella	4	Jan. 7, '02	Feb. 23, '02	"	----	med.	med.	med.	med.	med.
Adelaide	8	Aug. 14	July 3, '02	"	med.	high	med.	high	med.	high
Clare	14	Sept. 22	Farrow	"	med.	med.	med.	med.	med.	med.
MAX BELLE	9	Aug. 23	Jan. 19, '02	"	high	med.	high	med.	high	med.
Lucerne	8	Nov. 7	Dec. 29	"	high	high	high	high	high	med.
Serena	5	Dec. 8	Feb. 18, '02	"	----	med.	high	med.	high	med.
Rosemary	7	Dec. 25	Mch. 27, '02	"	----	high	high	high	high	high
Fresno	3	Nov. 15	Mch. 31, '02	No. 3	med.	low	med.	low	med.	low
Santa Rosa	3	May 2	Oct. 8	"	low	low	low	low	low	----
Eva	9	Nov. 3	Feb. 2	"	----	low	med.	low	med.	low
Mermaid	6	Feb. 11, '02	Sept. 4, '02	"	----	----	----	low	low	low
Santa Clara	3	April 2	Oct. 6	"	med.	med.	med.	----	----	----
VERMONT UNA	2	Dec. 12	Aug. 3, '02	"	----	----	----	low	low	low
Pretoria	5	Sept. 1	Dec. 22	"	low	med.	low	med.	low	med.
Pauline	6	Farrow	Farrow	"	med.	med.	med.	med.	med.	med.
Inez	9	Jan. 4, '02	Feb. 25, '02	"	----	----	med.	high	med.	high
Pomona	10	Dec. 28	Feb. 24, '02	"	----	med.	med.	med.	med.	med.
LADY PERUSIA	8	April 14	Feb. 20, '02	"	high	med.	high	med.	high	med.
Powella	9	May 10	July 27	"	high	high	high	----	----	----
Red Top	12	Aug. 27	Farrow	"	med.	high	med.	high	med.	high
Ceres	11	Jan. 15, '02	Mch. 27, '02	"	----	----	high	high	high	high
Malt sprouts vs. cottonseed and linseed meals										
Flora	12	April 21	Oct. 23	----	1	4	1	4	1	----
Fairie	12	June 9	Nov. 8	----	4	4	4	4	4	4
Sadie	4	Nov. 28	May 5, '02	----	1	4	1	4	1	4
Edith	4	Sept. 8	April 16, '02	----	1	1	1	1	1	1
Dried brewers' grains vs. cottonseed and linseed meals										
Eunice	4	Aug. 31	Feb. 20, '02	----	3	1	3	1	3	1
Malt sprouts vs. ground oats										
Naomi	6	Dec. 26	May 31, '02	----	----	4	5	4	5	4
Primrose	9	Dec. 6	Mch. 27, '02	----	----	5	5	5	5	5
MINTA BELLA	10	Feb. 24	Aug. 26	----	4	5	4	5	----	----
Rosel	5	Farrow	Farrow	----	----	4	4	4	----	----
Dorothy	2	Jan. 23, '02	May 12, '02	----	----	----	4	5	4	5
Hallowe'en	8	Mch. 1, '02	July 31, '02	----	----	----	----	5	5	5
Corn silage vs. apple pomace silage										
Atalanta	12	Aug. 4 *	Oct. 24	----	silage	silage	pomace	silage	pomace	----
Surprise	1	Feb. 9, '02	Aug. 13, '02	----	----	----	silage	pomace	silage	silage
Jersey Lily 2nd	2	May 27	Dec. 14	----	pomace	pomace	pomace	pomace	pomace	----
Lavender	4	Farrow	April 4 '02	----	silage	silage	pomace	silage	pomace	silage
Sylvia	9	Farrow	Aug. 28	----	silage	pomace	silage	pomace	----	----
Mona	4	May 27	Oct. 19	----	pomace	pomace	pomace	pomace	pomace	----
Phyllis	3	Oct. 25	April 21, '02	----	silage	pomace	silage	pomace	silage	silage
Sonoma	3	Sept. 7	April 6, '02	----	pomace	silage	pomace	silage	pomace	silage

Name	Approximate age Nov. 1	Calved 1901 or 1902	Served 1901 or 1902	Feed	Period numbers I	II	III	IV	V	VI
Experimental error										
Crystal Girl	2	Mch. 6, '02	May 13, '02		------	--------	--------	1	1	1
Low and high grade glutens										
BEAUTINA	10	Feb. 11, '02	Sept. 6, '02		------	--------	--------	6	7	6
Max Ella	10	Jan. 12, '02	May 11, '02		------	--------	6	7	6	7
Haidee	6	Feb. 3, '02	May 13, '02		------	--------	6	7	6	7
Star Bright	5	Jan. 2, '02	Feb. 25, '02		------	--------	7	6	7	6

*Aborted.

DATES OF FEEDING PERIODS

I Preliminary Dec. 7-17.
Experimental Dec. 17-Jan. 4

II Preliminary Jan. 4-14.
Experimental Jan. 14-Feb. 1

III Preliminary Feb. 1-11.
Experimental Feb. 11-Mch. 1.

IV Preliminary Mch. 1-11
Experimental Mch. 11-29.

V Preliminary Mch. 29-Apl. 8.
Experimental Apl. 8-26.

VI Preliminary Apl. 26-May 6.
Experimental May 6-24.

MILKING AND MILK SAMPLES

Every milking was weighed from the outset to the end of the feeding trials. Composite samples of nine milkings each were taken continuously throughout both the preliminary and the experimental portions of the periods, with the exception of one day in the middle of the preliminary portion of each period. These were analyzed by the Babcock centrifugal method for fat, while the total solids were furnished by the Quevenne lactometer, the Hehner and Richmond formula ($T=1.2\ F+\frac{L}{4}+0.14$), the fat percentage and the milk slide-rule.

FODDERS AND FEEDS

The silages and feeds were sampled on the sixth day of each preliminary and on the eighth and fifteenth day of each experimental portion of each period. The hays, separate lots from the main and from the annex barns, were sampled twice a week. There were taken in all 612 samples of roughages and of concentrates, silages in quadruplicate, hays in duplicate, concentrates singly. All samples were individually analyzed for their dry matter content, and were then combined to make 55 composite samples for complete analysis. Tables of analyses, of digestion co-

efficients, and of digestible nutrients appear in the appendix; the averages of these are shown on the next two pages.

The hay fed was in general a good grade of early cut hay of mixed grasses, mostly timothy, with considerable clover. So many cows were fed so long that it was impossible to feed an absolutely even grade throughout. In order to keep check on the character of the hay fed and to prevent too great variation in the ration, samples were taken every three days and nitrogen determinations made at once. Some divergencies occurred. The variations, however, were not extreme; hence it is felt that the averages given below, as well as the figures shown in the appendix and actually used, are entirely safe as indicating the quality of the hay eaten. That fed in the annex barn contained less clover than that used in the main structure.

The silage was made for the most part from matured Sanford corn, well eared. It kept well and was but slightly acid. Much of that fed in the second period was made from several large watery varieties of corn and contained considerably less food to a given weight than did that made from the Sanford corn. More, however, was fed to make up for the lessened food value.

The bran was roller process, Pillsbury make. Germ oil meal, a new feed in Vermont markets, is a product made from the germ of the corn kernel. Dried brewers' grains and malt sprouts are kiln-dried by products of the brewing industry. The character of the other feeding stuffs is sufficiently indicated by their trade-marks. The mixed feeds were made from time to time as needed in accordance with the formulas shown in the foot-note on the next page.

AVERAGE ANALYSES OF FODDERS AND FEEDS

Fodders and feeds	Original substance		Composition of dry matter							
	Water	Dry matter	Crude ash	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract	Nitrogen	Phosphoric acid	Potash
Hay (main barn)	11.18	88.82	8 66	11.66	32.73	44.64	2.31	1.87	0.58	2.84
Hay (annex barn)	12.53	87.47	7.48	9.69	35.61	45.22	2.00	1.55	0.60	2.38
Silage (mature corn)	68.49	31.51	5.76	9.14	19.11	62.77	3.22	1.46	0.60	1.66
*Silage (immature corn)	78.06	21.94	6.64	8.75	28.34	54.38	1.89	1.40	0.55	1.82
Apple pomace silage	79.30	20.70	4.77	8.28	21.23	59.07	6.65	1.33	0.37	1.12
†Mixed feed No. 1	10.83	89.17	6.61	29.47	10.46	47.60	5.86	4.72	2.81	1.68
" " " 2	10.26	89 74	4.06	23.93	9.29	52.60	9.12	3.83	2.18	0.68
" " " 3	10.05	89.95	4.99	26.30	13.98	48.06	6.67	4.21	1.70	0.74
" " " 4	11.55	88.45	7.68	27.20	12.96	49.20	2.56	4.35	2.13	2.20
" " " 5	12.47	87.53	6.89	17.73	10.86	59.34	5.18	2.84	2.49	1.63
" " " 6	12.30	87.70	5.38	25.16	7.61	56.63	5.22	4.03	2.55	1.21
" " " 7	11.13	88.87	5.32	28.06	7.52	54.73	4.37	4.49	2.35	1.11
Cottonseed meal	16.89	93.11	7.18	47.33	8.34	27.00	10.05	7.57	2.73	1.96
Linseed meal	10.85	89.15	6.92	45.62	8 46	36.60	2.40	7.30	1.97	1.55
King gluten meal (higher)‡	10.26	89 74	2.95	40.95	1.56	52.65	1.89	6.55	1.05	0.15
" " " (lower)‡	12.18	87.82	2.45	33.24	1.48	57.58	5.25	5.32	1.08	0.13
Germ oil meal	10.49	89.51	3.41	25.70	9.37	51.05	10.47	4.11	1.87	0.29
Malt sprouts	11,22	88.78	7.22	30.92	13.05	47.30	1.51	4.95	1.67	2.36
Dried brewers' grains	8.79	91.21	4.24	27.62	16.49	45.09	6.56	4.42	0.43	0.16
Wheat bran	12.33	87.67	7.17	19.26	11.70	56.30	5.57	3.08	3.17	1.82
Ground oats	12.48	87.52	5.05	13.66	10.27	67.12	3.90	2.19	0.86	0.82

* Fed in January.

† The mixed feeds were made up by weight as follows:

No. 1—Wheat bran 4, cottonseed meal 1, linseed meal 1.
" 2— " " 1, germ oil meal 2.
" 3— " " 1, dried brewers' grains 2.
" 4— " " 1, malt sprouts 2.
" 5— " " 2, ground oats 1.
" 6— " " 2, King gluten meal (lower grade) 1.
" 7— " " 2, " " " (higher ") 1.

‡ In protein.

AVERAGE DIGESTIBLE INGREDIENTS IN FODDERS AND FEEDS

Fodders and feeds	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1:
Hay (main barn)	53.29	5.90	16.87	25.37	1.16	7.6
Hay (annex barn)	52.48	4.83	18.06	25.32	1.00	9.4
Silage (mature corn)	24.05	1.97	4.93	15.61	0.81	11.3
Silage (immature corn)	15.94	1.08	4.37	8.83	0.48	13.2
Apple pomace silage	No digestion coefficients					
Mixed feed No. 1	59.7	21.8	3 8	30.1	4.1	2.0
Mixed feed No. 2	70.0	18.1	5.6	38.7	6.6	3.3
Mixed feed No. 3	55.8	18.7	6 0	26.9	5.1	2.4
Mixed feed No. 4	57.5	19.0	3.6	79.6	2.1	2.0
Mixed feed No. 5	56.9	12.1	2.5	37.4	3.3	3.9
Mixed feed No. 6	62.3	18.5	1.9	37.8	3.3	2.5
Mixed feed No. 7	63.1	21.0	1.9	37.0	2.8	2.2
Cottonseed meal	68.9	39 0	4.4	15.1	8.8	1.0
Linseed meal	70.5	35.1	6.1	27.4	2.1	1.1
King gluten meal (high grade)	80.9	32.8	--	42.1	1.6	1.4
King gluten meal (lower grade)	79.0	26.0	--	44.6	4.4	2.0
Germ oil meal	77.0	20.0	6 6	40.3	8.0	3.2
Malt sprouts	59.5	22.0	3.9	28.5	1.3	1.6
Dried brewers' grains	56.6	20.0	8.1	23.6	5.5	2.2
Wheat bran	54.4	13.2	3.0	33.9	3.4	3.4
Ground oats	61.3	9.4	1.8	44.3	2.9	5.6

RECORDS OF THE FEEDING TESTS

The experimental feeding and care of 56 cows for from three to five and a half months involved a vast amount of labor. It necessitated about 50,000 barn weights and records, the analysis of 612 samples of fodders and feeds for dry matter, of 55 similar materials for the various crude nutrients (complete analysis) and of about 1500 composite samples of milk for fat and specific gravity. And, finally, many hundreds of hours of work were spent in the collation and calculation of the multitudinous records of the tests in preparation for publication. All the mathematical work in connection with this, as with all other similar station work, was done in duplicate, usually by different persons, was cross-checked wherever possible, and was accomplished so far as might be with the aid of calculating instruments and tables. It is thought to be absolutely accurate. The detailed data if printed would well nigh double the size of this report. Even when condensed into the briefest possible compass it occupies much space. Our usual custom of placing in an appendix the condensed data which form the basis for the conclusions has been followed in the present case. It is there of ready reference to those interested, but does not stand in the way of that larger class of readers who care only for the text and for the smaller tables showing final results. Only such tabular matter as is needed

to explain the text is included in the body of the articles. The main tables appear in the appendix to this volume under the following headings:

APPENDIX CONTAINING CONDENSED DATA PERTAINING TO ARTICLES ON FEEDING TRIALS WITH COWS

I. Weights of cows.
II. Average barn temperatures, with ranges and percentages of uniformity.
III. Analyses and digestible ingredients in fodders and feeds; (*a*) analyses on dry basis; (*b*) digestion co-efficients; (*c*) pounds of digestible nutrients in 100 pounds of original substance.
IV. Feeding records of the individual cows in feeding tests.
V. Production records; showing production and same per unit for each individual cow in feeding tests.
VI. Difference tables. (*a*) Totals of differences; (*b*) Percentage differences.
VII. Results of experimental feeding on different rations.

This appendix is omitted in the general edition, since it is composed simply of a mass of figures, of interest only to the student of animal husbandry and as a matter of record showing the basis for the conclusions drawn from these trials. Copies may be obtained on application by such parties as may desire it. It is printed in the edition sent to the experiment station and library mailing lists.

III. HOW MUCH GRAIN MAY BE FED WITH PROFIT TO COWS?

This station has now during three successive seasons tried to aid in the solution of the important question used as a caption to this article. The matter has been referred annually for adjudication to juries consisting of from 12 to 20 cows. Two verdicts have been rendered, and a third is about to be handed in.

The reasons why there is need of an answer to such a question, and why it is particularly fitting that this station should try to answer it have been fully detailed in previous reports and need not be dwelt upon here. No one trial or series of trials, however, can settle the matter; and so, notwithstanding the three years of work, further tests are designed for the coming winter to study more particularly the advisability of using extremely restricted grain rations.

GENERAL PLAN

The trials of the past season were planned much as were those of the preceding year. It was expected to use twenty-eight cows; but as

a matter of fact only twenty-four were employed, for errors in feeding, early drying off and late calving vitiated the records of four animals. Two grain rations were fed. The feeding plan contemplated that four be fed on mixed feed 2 in low and in medium amounts; and that three others receive the same in medium and high amounts. Four others were to be fed mixed feed 3 in low and in medium quantities; and yet another three were to receive this ration in medium and high amounts. These fourteen cows were fed these competing rations in the time-honored fashion of alternation. The other fourteen cows, chosen like their mates in the other part of the test as a result of a careful study of their past histories and of their conditions at the opening of the trials, were pitted against the first fourteen in continued instead of alternating feeding. Three were to be kept continuously throughout the trials (while in milk) on low rations, two on medium, and two on heavy rations on mixed feed 2, and, similarly, a lot of seven on low, medium and high rations on mixed feed 3.

This plan was carried out except as modified by the untoward circumstances noted above. The records of twenty-six cows are included in the tables; but owing to Santa Clara's early drying and Vermont Una's very late calving their records are of no service in this particular connection. They are serviceable in test *g* (experimental error).

FEEDING

Thirteen of the twenty-four cows were fresh, five had been in milk from three to five months, five from seven to nine months, and one was farrow. Twenty were mature cows of five years or more, and four were two or three-year-olds.

The grain rations fed were No. 2 (bran 1 part, germ oil meal 2 parts by weight) and No. 3 (bran 1 part, dried brewers' grains 2 parts). Both rations were readily eaten.

COMPARISON WITH STANDARDS [1]

Wolff.—Low ration.—Digestible protein was always short while other nutrients were sometimes lacking, sometimes equal to, and sometimes in excess of standard amounts. *Medium ration.*—Total and digestible food as well as the sundry nutrients were eaten by all but one of the cows in quantities equal to or in excess of standard. *High ration.*—All the cows ate much more than standard indicated.

[1] The reader's attention is called to the full discussion of the nature and usefulness of standards in bulletin 81 of this station entitled "Principles and Practice of Stock Feeding." This bulletin of 56 pages will be sent without charge, on application.

Wolff-Lehmann.—Low ration.—The cows generally ate enough or more than enough of digestible food and of the several nutrients to meet standard, but they seldom ate enough total dry matter.[1] Protein consumption was frequently low of standard. *Medium ration.*—All the cows ate enough and to spare of digestible food and food nutrients, but several failed to eat the total dry matter which the standard requires.[1] *High ration.*—All the cows ate an excess of all the nutrients. Three, however, failed to consume the requisite amount of total dry matter.[1]

RESULTS

For convenience of discussion the results of the two methods of experimentation—by alternate periods and by continuous feeding combined with alternation—are considered together on page 288. The results will be contrasted in another article further on in this report which has to do with the comparative merit of the two methods as means of arriving at truth.

As has been already remarked, the data of these feeding trials, although greatly condensed, are, notwithstanding, voluminous. As few figures as possible are given in the text. It is thought, however, that the scheme of tabulation and the true meaning of the figures are made clear by the captions of the tables and by the note at the bottom of the next page.

The tables on page 288 show the results by the alternation method. They also show the effects of continuous feeding. They are summarized from tables VI (*b*) and VII at various points in the appendix and show the increase or decrease—expressed in percentages, total equalling 100—in the dry matter eaten, in the milk, total solids and fat yielded, and in the products to 100 pounds of dry matter eaten when:

Table 1. Hay, silage and 8 pounds of grain were fed instead of hay, silage and 4 pounds of grain, or vice versa (*medium and low grain feeding*).

Table 2. Hay, silage and 12 pounds of grain were fed instead of hay, silage and 8 pounds of grain, or vice versa (*high and medium grain feeding*).

Table 3. Hay, silage and 4 pounds of grain were fed in comparison with the same.

Table 4. Hay, silage and 8 pounds of grain in comparison with the same.

Table 5. Hay, silage and 12 pounds of grain were fed in comparison with the same.

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[1] The Wolff-Lehmann total dry matter standard for fresh cows is extremely high, too high for the generality of American cows and American fodders, feeds and rations.

Tables 3 to 5 show the increase or decrease in consumption and production when no change whatever was made, when the low or the medium or the high ration was fed continuously. This comparison is, in a measure, a check upon the work, since it shows what might be termed the experimental error—and its probable extent—incident to the method of feeding and to the scheme of calculation used. The comparatively even run of figures and their relatively low value add strength to the conclusions which may be drawn from the other data.

It should be noted that in tables 1 and 2 (*a*) indicates the percentage results obtained when the second named ration was substituted for the first—the former being always the richer ration; that (*b*) represents the outcome when the poorer ration was substituted for the better one; and that (*c*) shows the percentage gain or loss sustained from 144 to 198 days' feeding on the richer as compared with the poorer ration. These three comparisons were obtained with the same cows in the same series of tests. They are arrived at, however, in three different ways, yet they all tell much the same story.

The different rations had the following nutritive ratios:

	Low feeding		Medium feeding		High feeding	
	Range	Average	Range	Average	Range	Average
No. 2	1:6.3—1:7.3	1:6.9	1:5.5—1:6.5	1:6.0	1:5.3—1:6.2	1:5.6
No. 3	1:5.7—1:7.0	1:6.5	1:5.2—1:6.0	1:5.4	1:4.3—1:5.0	1:4.8

NOTE.—The tables on page 288 and several others in sections of this article numbered IV to VIII are so very highly condensed that, unless further explained, they are likely to prove unintelligible. In the first place the reader is directed to the three pages of text at the end of the appendix, explanatory of the so-called "difference tables." The nature of these tables—which aim to measure the relative feeding values of the sundry rations,—and of the summaries given in the text of this article is shown therein at length.

The tables 1 to 5 given herewith, as well as the several following printed in the discussion, show the *increase or decrease, as the case may be, in the amounts of dry matter eaten, of milk, solids and fat yielded, and of production proportioned to 100 pounds of dry matter, when one ration replaced another.* These increases and decreases are expressed as *percentages* of the total, total equalling 100. Thus for example the cows fed low and medium rations for 144 days on each (fifth line table) ate 3126 pounds of dry matter when getting the lower and 3614 pounds of dry matter when fed the medium ration. They ate 488 pounds more dry matter (3614—3126) on the latter ration than on the former. This is an increase of 16 percent (488+3126=16+) over the feeding on the low ration. This figure, +16, an increase of 16 percent in dry matter, appears in the appropriate column in the fifth line of table 1, immediately to the right of the figure 144. It shows that when a change was made from a low to a medium grain ration 16 percent more dry matter was eaten as a result of that change than was consumed on the scantier feed. In other words +16 is in this case the "percentage of increase," "total (3126) equalling 100." All the other figures, be they + or —, increases or decreases, in these and the similar tables further along in this article, were thus derived and have a similar significance.

SUMMARY OF DIFFERENCE TABLES, ETC., (APPENDIX VI (*b*) AND VII)

RATIONS	Periods represented or days of feeding	Total dry matter eaten	Dry matter eaten in experimental feed	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter: Milk	Total solids	Fat	Ratio of fat to solids-not-fat
(*a*) When changed from the lower to the higher ration												
(*b*) When changed from the higher to the lower ration												
(*c*) When changed from the lower to the higher ration												
TABLE 1. MEDIUM AND LOW GRAIN FEEDING												
(*a*) Low to medium*	3	+17	.....	+11	0	+1	+11	+12	−4	−5	−4	....
(*a*) Low to medium†	6	+17	.....	+ 9	+1	+1	+11	+12	−9	−8	−7	....
(*b*) Medium to low*	5	−13	.....	− 9	−1	−2	− 0	−12	+2	+1	0	....
(*b*) Medium to low†	5	−13	.....	−13	0	0	−13	−13	+3	+3	+3	....
(*c*) Low to medium*	144	+16	+100	+11	0	+1	+11	+13	−3	−2	−1	−1
(*c*) Low to medium†	198	+16	+ 96	+ 9	0	+1	+10	+13	−6	−6	−5	−1
TABLE 2. MEDIUM AND HIGH GRAIN FEEDING												
(*a*) Medium to high*	6	+ 9	.....	−1	0	+1	− 1	0	− 9	− 9	− 9	....
(*a*) Medium to high†	5	+10	.....	+3	0	−1	+ 3	+ 3	− 5	− 6	− 6	....
(*b*) High to medium*	5	− 9	.....	0	0	−1	0	− 1	+10	+10	+10	....
(*b*) High to medium†	5	− 9	.....	−3	+1	+2	− 3	− 3	+ 6	+ 6	+ 7	....
(*c*) Medium to high*	198	+10	+50	−1	0	+1	0	0	− 9	−10	− 9	−1
(*c*) Medium to high†	180	+10	+46	+3	−1	−1	+ 3	+ 3	− 5	− 6	− 6	+1
TABLE 3. LOW AND LOW GRAIN FEEDING												
Low*	5	− 1	− 2	+ 1	0	0	0	0	+1	+ 1	+ 1	....
Low†	5	0	0	0	0	0	0	0	−2	− 2	0	....
Low*	90	− 4	− 1	− 1	0	0	−1	−2	+2	+ 3	+ 2	+1
Low†	90	+ 6	0	+ 1	0	+1	+1	+2	−4	− 4	− 3	−3
TABLE 4. MEDIUM AND MEDIUM GRAIN FEEDING												
Medium*	7	+ 1	0	+ 1	0		+10	0	0	0	− 1	....
Medium†	8	+ 1	+ 1	+ 1	0	−1	0	+1	0	− 2	− 2	....
Medium*	126	+ 5	− 1	+ 1	0	0	+1	+1	−4	− 3	− 4	0
Medium†	144	0	0	+ 2	0	0	+1	+1	0	0	− 1	0
TABLE 5. HIGH AND HIGH GRAIN FEEDING												
High*	7	+ 1	− 2	0	0	0	0	0	−1	− 2	− 1	....
High†	3	− 2	+ 3	+ 1	0	0	+1	+2	+1	+ 2	+ 3	....
High*	126	+ 1	+ 3	+ 1	−1	−2	0	−1	−1	− 2	− 2	+ 2
High†	54	− 1	+ 6	+ 1	+1	+2	+2	+4	+1	+ 1	+ 4	− 2

The next set of tables shows the outcome by the other method of experimentation, wherein a combination is used of the continuous and the alternating systems. A full discussion of this method with the condensed data on which this table is based is found in the article entitled "A Comparison of Feeding Trial Methods" further on in this volume.

* Mixed feed No. 2 use

† Mixed feed No. 3 used.

CHANGES IN PRODUCTION, EXPRESSED AS PERCENTAGES, RESULTING FROM CHANGING RATIONS

Nature of change in ration	Number of comparisons	Total dry matter eaten	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter		
								Milk	Total solids	Fat
Low to medium	4	+17	+14	0	0	+15	+14	− 2	− 1	− 2
Medium to low	4	−12	− 6	−1	−2	− 7	− 8	+ 6	+ 5	+ 4
Medium to high	3	+11	+ 1	−1	0	0	+ 1	−10	−11	−10
High to medium	5	−9	− 2	+1	0	− 1	− 1	+ 9	+ 9	+ 9

RESUMÉ

The strict verbalized summary to be made from table 1,—which is typical of that which might be drawn from table 2, and from several others following in this article—may be stated as follows:

1. Seventeen percent more dry matter fed in the medium rations than was eaten of the low rations produced 10 percent more milk, 11 percent more total solids and 12 percent more fat, but at the expense of 7, 7 and 6 percents respectively of dry matter. (*a*)

2. Thirteen percent less dry matter fed in the low rations than was consumed when the medium rations were given, made 11 percent less milk and 12 percent less solids and fat, but at a saving of from 2 to 3 percent of dry matter. (*b*)

3. Sixteen percent more dry matter fed for 342 days in the medium rations than was eaten in the same time on the lower feeds made 10 percent more milk and solids and 12 percent more fat, at the expense of from 3 to 5 percent more dry matter. (*c*)

This statement is exact and categorical. It is the direct interpretation of the tabulated data into text. But its meaning is somewhat hard to grasp, and the real outcome, expressed in brief and luminous sentences, is not shown. It has been deemed expedient therefore to make the verbal conclusions less exact but not less correct as generalizations. This course will be taken with all the tabulations of this character throughout this article.

The outcome as regards production and economy of production in this series of trials—as judged by both methods of measurement, the alternating and the combined,—may be stated in the following inferences:

1. *Low and medium grain feeding.*—When 4 pounds of grain were added to a ration of hay, silage and 4 pounds grain (making 8 pounds

of grain in all) there were made from 9 to 13 percent more milk, total solids and fat. The quality of the milk remained unaltered. The increase in dry matter eaten was 17 percent; hence 100 pounds of dry matter made about 5 percent less product on the medium than it did on the poorer ration.

2. *Medium and low grain feeding.*—Dropping 4 pounds of grain from a ration of hay, silage and 8 pounds of grain resulted in from 9 to 13 percent lessened production. The quality of the flow was not altered. There was 13 percent less total dry matter eaten; hence a unit of dry matter made from 2 to 3 percent more milk, total solids and fat on the poorer than were made on the better ration.

3. *Medium and high grain feeding.*—When 4 pounds of grain were added to a ration of hay, silage and 8 pounds of grain (making 12 pounds in all) a 3 percent increase in milk, solids and fat was obtained in one case and equal quantities in the other. Ten percent more dry matter was eaten; hence a pound of dry matter made from 6 to 9 percent less product on the high than it did on the medium ration. No material change was observed in the quality of the milk.

4. *High and medium grain feeding.*—When 4 pounds of grain were dropped from a ration of hay, silage and 12 pounds of grain, production was lessened 3 percent in one case and, in the other, remained unaffected. The quality of the milk was not modified as a result of the changed ration. There was 9 percent less dry matter fed and the producing power of a unit of dry matter was raised from 6 to 10 percent.

5. *Uniform feeding.*—(Tables 3-5). Twelve comparisons of uniform feeding covering 35 period comparisons and 630 days feeding on each side of the equation are at hand and may be summarized as follows:

When like rations were fed at diverse times, and when, by calculation, the effects of advancing lactation had been so far as might be neutralized, the results arrived at by comparing calculated and actual yields were found to be closely alike. An average of 1 percent more product was made at one time than at another, the dry matter consumption being unaltered. A unit of dry matter made 1 percent less as calculated than was actually yielded. The quality of the milk was uniform throughout.

The outcome of these trials summarized from the standpoint of product rather than of feeding may be stated as follows:

1. *Quantity.*—The more grain, the more milk, total solids and fat The gains were not in proportion to the increase in grain feeding, being two-thirds as great when 8 pounds of grain were fed instead of 4 and perhaps one-sixteenth as great when 12 pounds were substituted in lieu of 8 pounds.

2. *Quality.*—No changes worth chronicling were observed.

3. *Economy of production.*—A pound of dry matter went further and made more milk, total solids and fat on the low than it did on the medium, and on the medium than it did on the high ration.

4. *Live weight.*—About two-thirds of the cows responded to radical changes in the amount of grain fed by gaining flesh or losing it according as feed was added or withdrawn. Those uniformly fed as a rule about held their own.

The following tables show the general outcome of the three years' trials, the first by way of figures, expressed as percentages, the second graphically by way of signs. They show on the whole a general uniformity in the trend of results.

RESULTS OF LOW, MEDIUM AND HIGH GRAIN FEEDING

When the ration changed	Quantity of production			Quality of product			Economy of production		
	1900	1901	1902	1900	1901	1902	1900	1901	1902
From low to medium	+7 to +10	+7 to +11	+9 to +13	+2	+1	+1	−4 to −6	−7 to −8	−3 to −7
From medium to low	−10	−8	−9 to −13	−1	0	−1	+2 to +4	+8 to +10	0 to +3
From low to high	+20	----------	----------	+1	----	----	−3 to −6	----------	----------
From high to low	−15 to 20	----------	----------	+6	----	----	−1 to +5	----------	----------
From medium to high	+7 to +10	+2 to +4	−1 to −3	0	−2	0	−1 to +1	−8 to −9	−6 to −9
From high to medium	−6 to −10	−4 to −6	0 to −3	+4	+2	+1	−2 to +2	+8 to +10	+6 to +10
Uniform feeding	−2	−1	+1	+2	0	0	−2 to −3	−1	−1

RESULTS OF LOW, MEDIUM AND HIGH GRAIN FEEDING*

When the ration changed	Quantity of production			Quality of product			Economy of production		
	1900	1901	1902	1900	1901	1902	1900	1901	1902
From low to medium*	+	+	+	+	0	+	−	−	−
From medium to low	−	−	−	−	+	−	+	+	0 to +
From low to high	+	·		+			−		
From high to low	−			+			0 and +		
From medium to high	+	+	0 to +	0	−	0	0	−	−
From high to medium	−	−	0 to −	+	+	+	0	+	+
Uniform feeding	−	−	+	0	0	0	−	−	−

* This table is thus interpreted: A change from a low to a medium ration brought about a larger milk and butter yield (+ in the first three columns), and resulted, perhaps, in a slight increase in the quality of the milk (+, 0 and + in next three columns). It was less economical to make milk and butter from the medium than from the low ration (— in last three columns); or, in other words, the larger the grain feed the more it cost to make a pound of butter.

FINANCIAL CONSIDERATIONS

The discussion thus far has been directed to a consideration of the effect of increasing grain rations on production and on the economy of production. A more direct study of the financial side of the operation is now in order. *Does it pay to feed cows as much as 8 or 12 pounds of grain daily?*

The tables on the next four pages show:

1. The weights of the various fodders and feeds eaten.
2. The weights of milk and butter produced.
3. The money value[1] of the food eaten.
4. The cost of food for 100 pounds of milk and for 1 pound of butter.
5. Proceeds from butter sales at 20 cents a pound.[2]
6. The fertilizing value[3] of the rations.
7. The total value of all production (butter, skim milk[4] and two-thirds of fertilizing ingredients.)
8. Gain, net gain or loss, and daily net gain or loss of one ration compared with another.

These are shown for the experimental portions of the periods only. Lactation stages are exactly equalled by calculation; hence each ration has the same chance as its rival to prove its worth.

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[1] Hay $10, silage $3, bran $18.50, cottonseed meal $29, linseed meal $30.50, germ oil meal $28, dried brewers' grains $22, malt sprouts $22, ground oats $38, King gluten meal $28 to $28.50. These are average market prices for grain feeds (in the winter of 1901-1902) and average estimates of several prominent and successful farmers in various portions of the state of the money values of hay and silage at the barn ready for feeding.

[2] This is not the price the station gets for its butter but simply a statement of average butter values of late years. It is a low price as winter creamery butter has recently sold.

[3] Nitrogen 16½ cents, phosphoric acid 4 cents, potash 4¼ cents; 1902 trade values for the same ingredients of essentially similar availability in commercial fertilizers.

[4] Allowing 20 cents a hundred for skimmilk, its feeding value in our more recent experiments. This is a low price in view of the late high prices for pork.

COMPARATIVE VALUES OF VARIOUS RATIONS FROM THE FINANCIAL STANDPOINT

RATIONS	Hay	Silage	Wheat bran	Germ oil meal	Dried brewers' grains	Milk	Butter	Money value of food	Cost of food for 100 lbs of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.	cts	$	$
144 DAYS ON LOW RATION VS. 144 DAYS ON MEDIUM RATION (NO. 2, GERM OIL MEAL AND BRAN)												
Low	1782	3458	186	371	....	1902	125.2	20.83	109.5	16.6	25.04	13.80
Medium	1749	3357	369	739	....	2103	141.3	27.18	129.3	19.2	28.26	17.23
Differences in favor of medium ration						+201	+16.1	+6.35	+19.8	+ 2.6	+3.22	+3.43
Percentage differences						+ 11	+ 13	+ 30	+ 18	+ 16	+ 13	+ 25
198 DAYS ON LOW RATION VS. 198 DAYS ON MEDIUM RATION (NO. 3, DRIED BREWERS' GRAINS AND BRAN)												
Low	2231	4976	257	....	513	3259	177.1	26.78	82.1	15.1	35.42	18.44
Medium	2 99	4895	502	....	1004	3545	200.3	34.28	96.7	17.1	40.06	23.12
Differences in favor of medum ration						+286	+23.2	+7.50	+14.6	+ 2.0	+4.64	+4.68
Percentage differences						+ 9	+ 13	+ 28	+ 18	+ 13	+ 13	+ 25
342 DAYS ON LOW RATIONS VS. 342 DAYS ON MEDIUM RATIONS (NOS. 2 AND 3, BOTH RATIONS)												
Low	4013	8434	443	371	513	5161	302.3	47.60	92.2	15.8	60.46	32.23
Medium	3948	8252	871	739	1004	5648	341.6	61.45	108.8	18 0	68.32	40.36
Differences in favor of medium ration						+ 487	+39.3	+13.85	+16.6	+ 2.2	+7.86	+8.13
Percentage differences						+ 9	+ 13	+ 29	+ 18	+ 14	+ 13	+ 25

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; low ration $37.50, medium ration $43.36.

Difference in favor of the medium ration, $5.86.

Gain, ($5.86), less extra cost, ($6.35), gives net loss $0.49; daily net loss 0.34 cents.

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; low ration, $53.31, medium ration, $61.56.

Difference in favor of medium ration, $8.25.

Gain, ($8.25), less extra cost, ($7.50), gives net gain, $0.75; daily net gain, 0.48 cents.

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; low ration, ($90.81), medium ration, ($104.92).

Difference in favor of medium ration, $14.11.

Gain, ($14.11), less extra cost, ($13.85), gives net gain, $0.26; daily net gain, 0.08 cents.

RATIONS	Hay	Silage	Wheat bran	Germ oil meal	Dried brewers' grains	Milk	Butter	Money value of food	Cost of food for: 100 lbs. of milk	Cost of food for: 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.	cts.	$	$
198 DAYS ON MEDIUM RATION VS. 198 DAYS ON HIGH RATION (NO. 2, GERM OIL MEAL AND BRAN)												
Medium	2215	4909	490	975	----	3390	204.0	36.14	106.6	17 7	40.80	22.97
High	2094	4836	684	1365	----	3372	204.2	42.48	126.0	20.8	40.84	26.22
Differences in favor of high ration						− 18	+ 0.2	+6.34	+19.4	+ 3 1	+0.04	+3.35
Percentage differences						− 1	0	+ 18	+ 18	+ 18	0	+ 15
Medium	2236	4409	479	----	959	2909	176.2	33 02	113.5	18.7	35.24	22.31
High	2139	4356	696	----	1329	3004	181.6	38.64	128.6	21.3	36.32	25.79
Differences in favor of high ration						+ 95	+ 5 4	+5.62	+15.1	+ 2.6	+1.08	+3.48
Percentage differences						+	+ 3	+ 17	+ 13	+ 14	+ 3	+ 16
Medium	4451	9318	969	975	959	6299	380.2	69.15	109.8	18.2	76.04	45.23
High	4233	9192	1380	1365	1329	6376	385.8	81.11	127.2	21.0	77.16	52.06
Differences in favor of high ration						+ 77	+ 5.6	+11.96	+17.4	+ 2.8	+1.12	+6.83
Percentage differences						+ 1	+ 1	+ 17	+ 16	+ 15	+ 1	+ 15

180 DAYS ON MEDIUM RATION VS. 180 DAYS ON HIGH RATION (NO. 8 DRIED BREWERS' GRAINS AND BRAN)

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; medium ration, $61.90, high ration, $64.15.

Difference in favor of high ration, $2.25.

Gain ($2.25), less extra cost ($6.34), gives net loss $4.09; daily net loss 2.07cents.

Total value of butter, skimmilk, and tw thirds of fertilizing ingredients; medium ration, $55.10, high ration, $58.68.

Difference in favor of high ration, $3.58.

Gain ($3.58) less extra cost ($5.62), g es net loss, $2.04; daily net loss, 1.15 cents.

378 DAYS ON MEDIUM RATIONS VS. 378 DAYS ON HIGH RATIONS (NOS. 2 AND 3, BOTH RATIONS)

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; medium ration, $117.00; high ration, $122.82.

Difference in favor of high ration, $5.82.

Gain ($5.82), less extra cost, ($11.96), gives net loss $6.14; daily net loss, 1.62 cents.

RATIONS	Hay	Silage	Wheat bran	Germ oil meal	Dried brewers' grains	Milk	Butter	Money value of food	Cost of food for: 100 lbs. of milk	Cost of food for: 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.	cts.	$	$
90 DAYS ON LOW RATION VS. 90 DAYS ON LOW RATION (NO. 2, GERM OIL MEAL AND BRAN)												
Low (1)	1606	2087	120	238	----	1426	96.7	15.49	108.6	16.0	19.34	10.42
Low (2)	1608	2263	117	234	----	1411	94.9	15.67	111.0	16.5	18.98	10.56
Differences in favor of (1)						+ 15	+ 1.8	−0.18	− 2.4	− 0.5	+0.36	− 0.14
Percentage differences						+ 1	+ 2	− 1	− 2	− 3	+ 2	− 1
90 DAYS ON LOW RATION VS. 90 DAYS ON LOW RATION (NO. 3, DRIED BREWERS' GRAINS AND BRAN)												
Low (1)	949	2062	120	----	238	1545	86.4	11.62	75 2	13.4	17.28	7.97
Low (2)	951	2115	119	----	238	1557	88.6	11.72	75.3	13.2	17.72	8.05
Differences in favor of (2)						+12	+2.2	+0.10	+ 0.1	− 0.2	+0.44	+0.08
Percentage differences						+ 1	+ 3	+ 1	+ 1	− 1	+ 3	+ 2
126 DAYS ON MEDIUM RATION VS. 126 DAYS ON MEDIUM RATION (NO. 2, GERM OIL MEAL AND BRAN)												
Medium (1)	1405	3249	335	669	----	3139	167.8	24.04	76.6	14.3	33.56	15.17
Medium (2)	1407	3015	336	669	----	3170	168.6	23.71	74.8	14.1	33.72	14.95
Differences in favor of (2)						+ 31	+ 0.8	− 0.33	− 1.8	− 0.2	+0.16	− 0.22
Percentage differences						+ 1	0	− 1	− 2	− 1	0	− 1

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; low (1) ration, $28.74; low (2) ration, $28.44.

Difference in favor of low (1) ration, $0.30.

Gain, ($0.30), plus lessened cost, ($0.18), gives net gain, $0.48; daily net gain, 0.53 cents.

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; low, (1) ration, $25.24, low (2) ration, $25.76.

Difference in favor of low (2) ration, $0.52.

Gain, ($0.52), less extra cost, ($0.10), gives net gain, $0.42; daily net gain, 0.47 cents.

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; medium (1) ration, $49.07; medium (2) ration, $49.13.

Difference in favor of medium (2) ration, $0.06.

Gain, ($0.06), less extra cost, ($0.33), gives net gain, $0.39; daily net gain, 0.31 cents.

RATIONS	Hay	Silage	Wheat bran	Germ oil meal	Dried brewers' grains	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.	cts.	$	$
144 DAYS ON MEDIUM RATION VS. 144 DAYS ON MEDIUM RATION (NO. 8, DRIED BREWERS' GRAINS AND BRAN)												
Medium (1)	1598	3358	365	....	731	2473	151.8	24 63	99.6	16.2	30.36	16.62
Medium (2)	1615	3592	369	....	738	2508	152.8	25.18	100.4	16.5	30.56	16.98
Differences in favor of medium ration (2)						+ 35	+ 1.0	+0.55	+ 0.8	+ 0.3	+0.20	+0.36
Percentage differences						+ 1	+ 1	+ 2	+ 2	+ 2	+ 1	+ 2

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; medium (1) ration, $45.68, medium (2) ration, $46.18.

Difference in favor of medium (2) ration, $0.50.

Gain, ($0.50), less extra cost, ($0.55), gives net loss, $0.05; daily net gain, 0.03 cents.

126 DAYS ON HIGH RATION VS. 126 DAYS ON HIGH RATION (NO. 2, GERM OIL MEAL AND BRAN)

High (1)	1342	3036	443	884	....	3010	183.7	27.30	90.7	14.9	36.74	16.87
High (2)	1377	3154	455	911	....	3034	184.4	28.12	92.7	15.2	36.88	17.38
Differences in favor of high ration (1)						+ 2.4	+ 0.7	+0.82	+ 2.0	+ 0.3	+0.14	+0.51
Percentage differences.						+ 1	0	+ 3	+ 2	+ 2	0	+ 3

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; high (1) ration, $53.16; high (2) ration, $53.68.

Difference in favor of high (2) ration, $0.52.

Gain, ($0.52), less extra cost, ($0.82), gives net loss, $0.30; daily net gain, 0.24 cents.

54 DAYS ON HIGH RATION VS. 54 DAYS ON HIGH RATION (NO 3, DRIED BREWERS' GRAINS AND BRAN)

High (1)	589	1290	20'	....	399	1340	79.4	11.23	83 8	14.1	15.88	7.49
High (2)	565	1403	203	....	403	1349	82.5	11.34	84.1	13.7	16.50	7.55
Differences in favor of (2)						+ 9	+ 3.1	+0.11	+ 0.3	− 0.4	+0.62	+0.06
Percentage differences						+ 1	+ 4	+ 1	0	− 3	+ 4	+ 1

Total value of butter, skimmilk, and two-thirds of fertilizing ingredients; high (1) ration, $23.18; high (2) ration, $23.85.

Difference in favor of high (2) ration, $0.67.

Gain ($0.67), less extra cost, ($0.11), gives net gain, $0.56; daily net gain, 1.02 cents.

The following deductions seem warranted by the data in the foregoing tables:[1]

1. *Low and medium grain feeding.*—When the two rations used in this experiment were fed with hay and silage at the rate of 8 pounds instead of 4 pounds daily, from 9 to 11 percent more milk was made, and 13 percent more butter. The cost of feed for making this extra product was found to be 29 percent greater on the richer ration. It cost on the average 18 percent more to make a pound of milk and 14 percent more to make a unit of butter on the 8 pound than on the 4 pound ration. There was of course more skimmilk made on the former ration, and it contained on the average 25 percent more fertilizing ingredients. When these two items are reckoned in, the medium ration leads by a neck; if the increase of butter only is considered, the lower ration proved better, in that the money value of the increase in butter did not compensate for the extra cost of the grain. Using average figures only, the daily feeding of 4 pounds more grain for 216 days entailed an extra cost of $13.85, and an added butter yield worth $7.86 or a loss of $5.99. It also made 420 pounds more skimmilk and better manure. If the former be valued at 20 cents and two-thirds[2] of the latter is reckoned at the prices stated in the footnote on page 292, there is a gain of $6.25 as an offset against the loss of $5.99, a net gain of $0.26, or a daily net gain of 0.08 cents for each cow, as a result of feeding 8 pounds of grain daily instead of 4 pounds.

2. *Medium and high grain feeding.*—When the two rations used in these feeding trials were fed with hay and silage at the rate of 12 pounds daily instead of 8 pounds daily, there was made from 1 percent less to 3 percent more milk and from no increase to 3 percent more butter on the richer ration. It cost, however, 16 percent more to make a quart of milk and 15 percent more to make a pound of butter on the 12 pound than on the 8 pound ration. The extra skimmilk and manurial values enter into the problem as before. If they are not included the loss is very heavy; and even when these are allowed for,

[1] It should be noted in this connection that the prices used for roughage are relatively high, considerably larger than those often used in calculations of this character. It is also to be observed that the prices for grain are higher than in the west, and higher than have ruled prior to the year 1900. It is well understood that grain sold at extremely high figures in the winter of 1901-02. These factors serve to increase calculated costs and to decrease or, perhaps, obliterate profits. As the comparisons have only relative values, however, this is not a serious matter. It is referred to in order to forestall possible criticism as to the high cost for food of making a pound of butter. It would be easy to "figure" much cheaper milk and butter.

[2] It is uncertain how much of the plant food may reach the soil. This depends on many factors. It is conservative to estimate two-thirds as ultimately available.

the heartier feeding was carried on at a great loss. The daily feeding of 4 pounds extra grain instead of 8 pounds for 378 days cost $11.96 more and made only $1.12 worth more butter, a loss of $10.84. The increase in skimmilk and in manurial value, reckoned as before, form an offset of $4.70. The net loss is then $6.14, while the daily net loss for each cow is 1.62 cents, nearly a cent and two-thirds as a result of feeding 12 pounds of grain daily instead of 8 pounds.

The salient points of the tables on pages 293-296 and of the discussion following the same are given below. The table shows the days of feeding on each ration, the added cost for feed of the higher grade ration, the net gain from butter sales, the net loss when these alone are considered as an asset, the value of the skimmilk and of two-thirds of the manurial ingredients, the net gain from butter, skimmilk and manure and the net gain or loss from feeding one cow for one day.

RELATIVE VALUE OF LOW, MEDIUM AND HIGH FEEDING[1]

	Medium better than low ration	High better than medium ration
Days of feeding on each ration	342	378
Cost of added grain feed	$13.85	$11.96
Net gain from butter sales @ 20 cents	$ 7.86	$ 1.12
Net loss, i. e. cost of additional grain less value of butter	$ 5.99	$10.84
Value of skimmilk and of two-thirds of the manurial ingredients	$ 6.25	$ 4.70
Net gain, or loss, from butter, skimmilk and manure	$ 0.26 gain	$ 6.14 loss
Net gain, or loss, from one day's feeding of one cow	0.08 cents gain	1.62 cents loss

3. *Uniform feeding.*—When unchanged rations were fed the results, as might have been expected, were fairly uniform. One per cent more milk and from no increase to 4 percent more butter were made at one time than at another. The money values of the food eaten and the costs of food for making milk and butter varied but little. Yet when these relatively small differences are translated into terms of dollars and cents quite considerable differences occur, notably in the last comparison.

4. *Does it pay to feed a low grain ration (4 pounds daily)?*—In the first year's trials the substitution of a medium (8 pound) ration for a low (4 pound) one was followed by a daily gain of 0.56 cents per cow. This gain was but 0.08 cents the second year and only 0.07 cents during the past season. At no time did the increase in butter pay for

[1] Neither in this comparison nor in those of a similar nature following in this article are the costs of the manufacture of the product, of marketing it, of caring for the cows, etc., considered. They would be essentially the same on both sides, and to admit them would obscure the only important point, namely, the comparison of the feeding values of the rations. The figures arrived at have no absolute values, but are serviceable solely for comparative purposes.

the extra grain; but every time the comparison has been made the total increase in immediate cash (butter money), pork (skimmilk), and plant food (the enriched manure) has more than equalled the additional outlay for grain. The margin, however, has twice been so small as to be hardly worth reckoning. Viewed simply from the standpoint of financial gain or loss the wisdom of feeding the extra 4 pounds of grain seems at best open to question.

5. *Does it pay to feed a high grain ration (over 8 pounds daily)?* —No. The first year trials showed a gain of 0.48 cents, last year's a loss of one cent and the present tests a loss of nearly a cent and two-thirds daily per cow when 12 pounds of grain were fed instead of 8 pounds. If butter returns only are considered the losses are far greater than these figures, which represent the outcome when extra butter, skimmilk and manurial values are all reckoned as assets. Not only may money loss be anticipated, but bovine health may be shattered and future usefulness be lessened as a result of high pressure feeding. Such practice may be advisable under exceptional circumstances, perhaps once in a thousand times, but it is folly on the generality of Vermont farms.

6. *What is the best grain ration?*—This query is a common one. It is a dull week when the mail fails to contain a letter seeking our judgment as to the best feeding ration. But we have never told what it was,—for we do not know nor do we ever expect to know what is best. Good rations can be formulated; but it is a bold—or an ill-informed—man who would declare any ration the best. Our usual practice when this question is asked is to send bulletin 81 on stock feeding; to point out the several factors which determine the value of a ration; to indicate the roughages which seem most advisable,—early cut hay, clover hay, mature corn silage, apple pomace silage; to mention the concentrates which, as prices for the current year run, seem most economical, bearing in mind, of course, their feeding and fertilizing values, their effect on the animal and its products, etc.; to lay emphasis on the importance of good cows if good food is used and on the folly of feeding high grade rations to low grade cows; and to urge the questioner to study the bulletin and to work out his own ration—under advice if desired—believing that if a farmer has once mastered the principles and fathomed the mathematics of dairy feeding he would become the better feeder thereby and be the more likely to make a success of his calling.

While it seems inadvisable to define the best grain ration as to its makeup, one may speak more directly as to its amount. Twelve

pounds is excessive and unwise; ten pounds may occasionally pay its cost over a lesser amount, but this is likely to occur very rarely. Two pounds is so little that even with a full amount of roughage cows would be apt to fail to make satisfactory returns; four pounds, when roughage is good and plentiful, is likely to yield total returns nearly equal to those afforded by an eight pound ration, and to prove the better of the two if skimmilk and manurial values be disregarded; but the residual effect of a low ration upon after production is not as apt to be satisfactory as is that following more liberal feeding. When all the different factors are taken into consideration, from six to eight pounds of grain daily seem the most advisable amounts te feed mature cows, eight in years when grain is relatively cheap and six when prices rule high. Four pounds of grain daily does good service for four weeks, and indeed, it may for four months; but will it prove equally as satisfactory for four years, in regular, practical, every day feeding? The writer believes that in the long run a more liberal ration would prove more satisfactory.

It should be remembered that in the three years' trials, on which, together with much other experience and observation, this judgment is based, the roughages were of the best and were fed with a free hand. The cows, even when on a low grain ration, had nearly or quite enough to eat. Heavy grain feeding would undoubtedly have proven a better practice and low grain feeding would surely have shown a less satisfactory outcome had it not been for this fact. In the lack of plentiful roughage supplies grain rations need proportionate modification.

As has been noted in previous reports, trials made at the Wisconsin station amply bear out the conclusions arrived at in our own investigations as to the folly of heavy grain feeding. Apparently further inquiry in that line is unnecessary, the results of five years' experience at two different stations, arrived at by two different methods of experimentation, being against it. But more light is needed as to the value of the low grain ration; and it is hoped that further work at this station in years to come may aid in diffusing some of that light.

IV. THE FEEDING VALUE OF MALT SPROUTS

(1) AS COMPARED WITH A COTTONSEED-LINSEED AND BRAN MIXTURE (NO. 1).

(2) AS COMPARED WITH A BRAN AND OATS MIXTURE (NO. 5).

Malt sprouts are seldom fed in Vermont. Their very name doubtless prejudices many against them. They are, however, largely used and highly prized in many dairy sections in this and other countries.

Yet, so far as the writer can determine, no feeding experiments with cows using this concentrate have thus far been made at an American experiment station. In order to bring this feed to the attention of Vermont feeders and to make good in part this apparent deficiency, a series of trials were instituted to compare the feeding value of malt sprouts with sundry standard concentrates.

Malt sprouts are a residue of the brewing industry. Barley grains are sprouted in the process of malting, and, in due course, are rubbed off and sold, either wet or dry, as a cattle food. They enter the general market solely in the kiln-dried form. They are small, comma-shaped, light yellow-brown particles of an agreeable nutty odor and crisp texture. When fed dry they are frequently refused by cows. If soaked some hours before feeding they are often better relished. The station herd did not take very kindly to the sprouts. Some of the cows ate them readily, others somewhat reluctantly, and others not at all, even when the sprouts were well soaked.

(1) AS COMPARED WITH A COTTONSEED-LINSEED AND BRAN MIXTURE (NO. 1)

This trial was one of rations with nutritive ratios nearly alike, not near enough to be equally balanced, but still closely similar in the proportions of digestible protein and carbohydrates.

FEEDING

Four cows, two mature and two young, the former well along in lactation, the latter fresh in milk, were fed in alternation and the others continuously on either mixed feed 1 or 4.

COMPARISON WITH STANDARDS

Wolff.—Each cow ate a sufficiency of total and of digestible dry matter and of each nutrient to satisfy standard requirements. Sadie and Edith ate very largely in excess of their needs as measured by standards.

Wolff-Lehmann.—Flora and Fairie on the No. 4 ration ate too little total dry matter; otherwise all consumption was equal to or in excess of standard requirements. Sadie and Edith in particular ate with much heartiness.

RESULTS

The following table summarized from those at various points in the appendix, shows the increase or decrease—expressed as percentages, total equalling 100—of dry matter eaten, of milk, total solids and fat given, and of the same per 100 pounds of dry matter eaten, (as measured by the alternation and, also, by the combined alternation and continuity method) when a cottonseed-linseed ration (No. 1)—

nutritive ratios ranging from 1:4.6 to 1:4.9 and averaging 1:4.8—replaced a malt sprouts ration—nutritive ratios ranging from 1:5.2 to 1:6.0 and averaging 1:5.5 or vice versa; hay and silage being fed as roughages throughout.

SUMMARY OF DIFFERENCE TABLES, ETC. (APPENDIX VI (*b*) AND VII)

RATIONS	Total dry matter eaten	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter: In entire ration: Milk	Total solids	Fat	Ratio of fat to solids-not-fat
Malt sprouts (actual) ± cottonseed-linseed (calculated)	−12	−11	+ 1	0	−10	−11	+ 2	+ 2	+ 1	
Cottonseed-linseed (actual) ± malt sprouts (calculated)	+12	+15	0	+ 1	+15	+16	+ 3	+ 3	+ 3	
126 days on malt sprouts ration ±126 days on cottonseed linseed ration	−11	−12	0	0	−11	−12	0	0	− 1	+ 2
Malt sprouts ± cottonseed-linseed (by contin.-altern. method)	− 6	− 7	+ 1	− 1	− 7	− 7	− 1	+ 1	− 1	

RESUMÉ

1. The dry matter consumption when the malt sprouts were fed dropped 10 percent; and so did the milk yield.

2. The quality of the milk was essentially the same on both rations.

3. The yield to the unit of dry matter was the same on both rations.

(2) AS COMPARED WITH A BRAN AND OATS MIXTURE (NO. 5)

The No. 5 mixture was quite some wider in its nutritive ratio than was its competitor, yet not enough so as to make the trial one of medium and wide rations; neither were the rations as closely alike in nutrients as were those used in the trial just considered.

FEEDING

Six cows, three mature, two five year olds and a heifer, four fresh in milk, and two far along in lactation were chosen. Three were fed in alternation, and two continuously on No. 5, and one continuously on No. 4.

COMPARISON WITH STANDARDS

Wolff.—Generally speaking, the cows ate enough and to spare of total and digestible dry matter and of the nutrients other than protein.

Minta Bella ate enough protein and much more than enough of the other nutrients. Rosel, heavy and far along in lactation, eating No. 4 reluctantly, did not consume enough to meet standard needs.

Wolff-Lehmann.—Two cows ate too little protein when on No. 5. With this exception standard or superstandard amounts of total dry matter, of digestible dry matter, and of the sundry nutrients were eaten. Naomi and Minta Bella in particular ate largely in excess of standard needs.

RESULTS

The following table summarized from those at various points in the appendix shows the increase or decrease—expressed as percentages, total equalling 100—in dry matter eaten, in milk, total solids and fat given and of products per 100 pounds of dry matter eaten, (as measured by the alternation and, also, by the combined alternation and continuity method), when hay and silage as roughages and a bran and oats ration (No. 5)—nutritive ratios ranging from 1:6.7 to 1:8.0 and averaging 1:7.1—replaced a malt sprouts ration—nutritive ratios ranging from 1:5.4 to 1:6.4 and averaging 1:5.8—or vice versa; hay and silage as roughages being fed throughout.

SUMMARY OF DIFFERENCE TABLES, ETC. (APPENDIX VI (*b*) AND VII)

RATIONS	Total dry matter eaten	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter: In entire ration: Milk	Total solids	Fat	Ratio of fat to solids-not-fat
Malt sprouts (actual) ± ground oats (calculated)	− 8	− 3	0	− 1	− 4	− 4	+ 6	+ 4	+ 3	
Ground oats (actual) ± malt sprouts (calculated)	+10	+ 3	+ 1	+ 1	+ 3	+ 4	− 8	− 7	− 6	
126 days on malt sprouts ± 126 days on ground oats	− 8	− 3	− 1	− 1	− 4	− 4	+ 7	+ 5	+ 4	+ 1
Malt sprouts ± ground oats (by contin.-altern. method)	−12	− 5	− 1	− 2	− 6	− 7	+ 8	+ 6	+ 6	

RESUMÉ

1. Although 9 percent less dry matter was eaten in the malt sprouts than from the ground oats ration the shrinkage in milk and milk constituents was but 4 percent.

2. The quality of the milk remained unaltered by the changes in feeding.

3. Since the shrinkage in yield when the malt sprouts were fed was proportionately less than that in consumption, it follows that the production to the unit of dry matter when this ration was eaten was more than when the oats were fed.

FINANCIAL CONSIDERATIONS

The following table shows the outcome of these two trials viewed from the money standpoint. Thirteen percent more milk and 14 percent more butter were made on cottonseed-linseed than on malt sprouts at a 10 percent increase in cost; thus the direct saving was only 3 percent. The former carried, however, 12 percent more plant food; hence the final outcome, using the assumptions hitherto mentioned is a daily net gain in favor of the cottonseed-linseed ration of 1.93 cents, practically half of which is due to the increase in the yield of butter and half to the added amounts of skimmilk and the extra manurial value.

The ground oats ration made 4 percent more product at an increased cost of 30 percent. The manurial values of each ration were essentially identical.

The extreme and prohibitive price asked for ground oats during the winter of 1901-02, a price unparalleled in decades, makes the showing very unfavorable to the ration of which they formed a part. The record is made in the following table, but it really has no bearing on ordinary conditions. One can simply say that the ground oats ration made more than did the malt sprouts ration. and ignore the relative costs.

RATIONS	Hay	Silage	Wheat bran	½ cottonseed ½ linseed meal; or ground oats	Malt sprouts or dried brewers' grains	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.	cts.	$	$
126 DAYS ON NO. 1 RATION VS. 126 DAYS ON NO. 4 RATION												
No. 1	1360	3002	669	336	....	2099	120.4	22.31	106.3	18.5	24.08	16.44
No. 4	1374	3327	293	....	511	1851	105.5	20.20	109.1	19.1	21.10	14.73
Differences in favor of No. 1 ration						+ 248	+ 14.9	+ 2.11	— 2.8	— 0.6	+ 2.98	+ 1.71
Percentage differences						+ 13	+ 14	+ 10	— 3	— 3	+ 14	+ 12
126 DAYS ON NO. 5 RATION VS. 126 DAYS ON NO. 4 RATION												
No. 5	1372	2920	610	304	....	1802	106.6	22.66	125.7	21.3	21.32	12.91
No. 4	1334	2885	213	....	406	1739	102.5	17.45	100.3	17.0	20.50	12.71
Differences in favor of No. 5 ration						+ 63	+ 4.1	+ 5.21	+ 25.4	+ 4.3	+ 0.82	+ 0.20
Percentage differences						+ 4	+ 4	+ 30	+ 25	+ 25	+ 4	+ 2
72 DAYS ON NO. 1 RATION VS. 72 DAYS ON NO. 3 RATION												
No. 1	816	1901	383	191	....	874	52.8	13.26	151.7	25.1	10.56	9.72
No. 3	799	1714	175	....	357	903	54.1	12.20	135.1	22.6	10.82	8.24
Differences in favor of No. 3 ration						+ 29	+ 1.3	— 1.06	— 16 6	— 2.5	+ 0.26	— 1.48
Percentage differences						+ 3	+ 2	— 8	— 11	— 10	+ 2	— 15

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration, $38.64; No. 4 ration, $34.10.

Difference in favor of No. 1 ration, $4.54.

Gain, ($4.54), less extra cost, ($2.11), gives net gain $2.43; daily net gain, 1.93 cents.

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 5 ration, $33.02; No. 4 ration, $31.96.

Difference in favor of No. 5 ration, $1.06.

Gain, ($1.06), less extra cost, ($5.21), gives net loss, $4.15; daily net loss, 3.29 cents.

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; No. 1 ration, $18.54; No. 3, ration, $17.86.

Difference in favor of No. 2 ration, $0.68.

Gain, ($0.68), less extra cost, ($1.06), gives net loss, $0.38; daily net loss, 0.58 cents.

V. THE FEEDING VALUE OF DRIED BREWERS' GRAINS

The cow Eunice, scheduled to alternate during the tests on the cottonseed-linseed and malt sprouts mixtures, persistently refused to eat any grain of which malt sprouts formed a part. She was, consequently, alternated on the cottonseed-linseed and dried brewers' grains mixtures (Nos. 1 and 3). Trials of a dried distillers' grains, sold under the name of Atlas gluten meal, were made some years ago at this station.[1] Brewers' and distillers' grains, however, are quite unlike and the former moreover are apt to be notably lower in protein than the latter.

Eunice was a four year old, three months in milk and she ate much more food than she needed, if we may judge by the Wolff standard or by that revised by Lehmann.

RESULTS

The following table summarized from those at various points in the appendix shows the increase or decrease—expressed as percentages, total equalling 100—of dry matter eaten, of milk, total solids and fat given, and of the same per 100 pounds of dry matter eaten, both in the total rations and in the experimental portions thereof, when a cottonseed-linseed ration (No. 1)—nutritive ratios ranging from 1:4.6 to 1:5.0 and averaging 1:4.8—replaced a dried brewers' grains ration (No. 3)—nutritive ratios ranging from 1:5.4 to 1:5.7 and averaging 1:5.5—or vice versa; hay and silage being fed as roughages throughout.

SUMMARY OF DIFFERENCE TABLES, ETC. (APPENDIX VI (*b*) AND VII)

RATIONS	Total dry matter eaten	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter						Ratio of fat to solids-not-fat
								In entire ration			In experimental fodder			
								Milk	Total solids	Fat	Milk	Total solids	Fat	
Dried brewers' grains (actual) ± cottonseed-linseed (calculated).	+ 2	−6	+2	0	0	+2	+2	0	+1	0	+ 8	+ 8	+ 8	
72 days' feed on dried brewers' grains ± 72 days' feed on cottonseed-linseed	+ 2	−7	+3	0	−1	+3	+3	+1	+1	0	+11	+11	+10	0

[1] Vt. Sta. Rpts., 9, pp. 222-223 (1895); 10, pp. 135-164 (1896); 11, pp. 311-346 (1897).

RESUMÉ

1. Two percent more dry matter was eaten on the brewers' grains than on the cottonseed-linseed ration and 2 percent more product was made.

2. The quality of the milk remained uniform on both rations.

3. The brewers' grains ration contained 2 percent more dry matter than did its competitor. The increase, however, was due solely to the roughages eaten, since the brewers' grains eaten carried 6 percent less dry matter than did the cottonseed-linseed mixture. Hence while the production to the unit of dry matter was unaffected by the change in rations, that to the unit in the experimental feed was in favor of the dried brewers' grain ration to the extent of 9 percent.

FINANCIAL CONSIDERATIONS

The table showing this point appears at the end of the last section (page 305). It there appears that the dried brewers' grain ration proved the better one, in that it made 3 percent more milk and butter at 8 percent less cost. The higher manurial value of the cottonseed-linseed ration gives it an advantage, which, however, is more than offset by its extra cost, so that the net daily loss from its use is 0.58 cents. Ignoring the manurial values this loss becomes 1.83 cents daily.

The results of this trial with a single cow are quite in unison with those attained elsewhere which accord to dried brewers' grains a high feeding value. It is unfortunate that they are not better appreciated by Vermont feeders.

VI. THE FEEDING VALUES OF KING GLUTEN MEALS OF RELATIVELY LOW AND HIGH PROTEIN CONTENTS

The King gluten meal found on sale in Vermont in 1901 was very uneven in composition, varying from 28 to 38 percent in protein. The former figure was 7.6 percent below guaranty. Apparently these differences were caused by a more than usually incomplete removal of starch from the lower graded goods. It seemed worth while to determine whether the cow would agree with the chemist, whether she would declare the 28 percent goods inferior for milk making to those carrying 38 percent protein. Accordingly two lots were purchased, one low and in the other high in protein. The average protein contents of the two lots as fed were 29.2 and 36.7 percents. These two meals were fed with hay, silage and bran (two parts bran and one of King gluten). When the more highly nitrogenous meal was fed 8 percent more digestible protein was eaten in the entire ration than when the lower grade goods were used.

FEEDING

Four cows, two mature, two, five year olds, all fresh in milk were fed the competing rations in alternate periods.

COMPARISON WITH STANDARDS

Wolff.—All four cows ate in excess of standard.

Wolff-Lehmann.—All four cows ate too little total dry matter as judged by the extremely high figure that the Wolff-Lehmann standard prescribes for heavy and fresh cows. This shortage also extended to the sundry nutrients in three cases. But one cow (Star Bright) seems to have eaten enough to meet this severe measure.

RESULTS

The following table summarized from various points in the appendix shows the increase or decrease—expressed as percentages, total equalling 100—in dry matter eaten, milk, total solids, and fat given, and of products per 100 pounds of dry matter, both in the total and the grain rations, when a ration containing a King gluten meal carrying nearly 37 percent of protein, was substituted for a King gluten meal analyzing but 29 percent, or vice versa—nutritive ratios being always 1:5.0 in the first case and either 1.5.4 or 1:5.5 in the second case; hay and silage as roughages and bran as the main concentrate being fed throughout.

SUMMARY OF DIFFERENCE TABLES, ETC. (APPENDIX VI (b) AND VII)

RATIONS	Total dry matter eaten	Dry matter eaten in concentrates	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In experimental feed: Milk	In experimental feed: Total solids	In experimental feed: Fat	Ratio of fat to solids-not-fat
Higher (actual) ± lower (calc.)	0	+	− 1	− 1	− 1	− 1	− 2	0	− 1	− 1	− 2	− 2	− 4	
Lower (actual) ± higher (calc.)	0	− 1	− 3	+ 1	+ 1	− 2	− 2	− 3	− 2	− 2	− 2	− 1	− 1	
126 days' feeding on the higher grade meal ± 126 days' feeding on the lower grade meal	0	+ 1	+ 1	− 1	− 1	0	− 1	+ 2	+ 1	0	0	− 1	− 2	+ 1

RESUMÉ

1. There was no difference in the yields of milk and butter on the two rations.

2. There was no variation in the quality of the milk as between the two rations.

3. The dry matter consumption being the same the yield per unit of dry matter was unchanged.

FINANCIAL CONSIDERATIONS

The following table shows the outcome from the standpoint of financial gain or loss. The richer ration made one percent more milk and one percent less butter than did the poorer one, and contained 5 percent more plant food. Its cost was 6 cents greater, its butter yield 26 cents less and the value of its plant food and skimmilk 79 cents greater than when its competitor was fed. Using the assumptions hitherto explained it is the better of the two by 21 cents in 126 days feeding. If the plant food and skimmilk items be ignored it is the worse by 32 cents.

The cow has not backed up the chemist in this trial. She did no better on the richer than on the poorer ration. She probably had enough to eat and enough of all the nutrients each time on each ration, the Wolff-Lehmann standard to the contrary notwithstanding; and, we are told, "enough is as good as a feast." Had the ration been at all scanty it is highly probable that more decisive results in favor of the better feed would have been attained.

COMPARATIVE VALUES FROM THE FINANCIAL STANDPOINT

RATIONS	Hay	Silage	Wheat bran	King gluten meal	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds from butter at 20 cents	Fertilizing value of food eaten
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.	cts.	$	$
126 DAYS ON NO. 6 RATION VS. 126 DAYS ON NO. 7 RATION											
Lower grade gluten	1397	3014	671	336	3202	181.8	22.07	70.3	12.4	36.36	15.07
Higher grade gluten ...	1407	3019	672	336	3226	180.5	22.57	70.0	12.5	36.10	15.82
Differences in favor of higher grade ration ..					+ 24	− 1.3	+0.06	− 0.3	+ 0.1	− 0.26	+0.75
Percentage differences.					+ 1	− 1	0	0	+ 1	− 1	+ 5

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; lower grade gluten ration, $51.91; higher grade gluten ration, $52.18.

Difference in favor of higher grade gluten ration, $0.27.

Gain, ($0.27), less extra cost, ($0.06), gives net gain, $0.21, daily net gain, 0.17 cents.

VII. THE FEEDING VALUE OF APPLE POMACE[1]

Apple pomace as a rule may be had for the hauling. Immense quantities of it go to waste yearly. Two trials hitherto reported[2] have indicated that it was well worth using; and further investigation but emphasizes the opinion heretofore expressed that its use was highly advisable. The station has fed it for three winters without apparently hurting either cows or product. It seems to have been capable of replacing corn silage pound for pound when a fair hay and grain ration was fed. No good reason for the continuance of the present wasteful practice can be advanced. It is criminal for a farmer to allow good cow food to be lost in the coming winter of scarcity.

Inasmuch as the station has found apple pomace to be a cheap and safe food, and since its corn crop did not fill the silos in the fall of 1901, several tons of pomace were obtained from a cider mill and ensiled for preservation.

FEEDING

Twelve cows were used. Four were so far along in lactation that they began to approach drying off during the third period and no serviceable results were attained. Of the eight whose records are of use, two were mature and six from four years old downwards. Two were about six months along, four comparatively fresh and two farrow. They were fed hay and mixed feed 1 throughout the experiment and, in alternating periods, corn silage and apple pomace silage. The pomace did not entirely replace the corn silage, the latter being cut down three-quarters in amount. The pomace silage was readily eaten and two cows were continuously fed thereon.

COMPARISON WITH STANDARDS

No digestion experiments have been published on apple pomace; neither is there basis for reasonable assumption as to its digestibility. It is hoped that tests of this matter may be made some day at this station. The pomace used in these trials contained a little more than two-thirds as much dry matter as did the mature corn silage and about the same as that in the immature silage used in the second period. Analyses show a somewhat close similarity in the dry matters of the pomace and the corn silage. The ether extract content was twice as great in the pomace as in the corn silage, and the protein somewhat less; otherwise figures are much alike. Its dry matter can hardly be as digestible as is that of silage because of the large proportion of core matter, seeds, etc. The total dry matter eaten when the pomace was fed averaged 6 percent less than when corn silage was used.

[1] Subsequent to the writing but prior to the printing of this article bulletin 96 on the feeding value of apple pomace using some of the data herein contained was printed. The short corn crop of 1902 made its early issuance highly necessary.

[2] Vt. Sta. Rpts., 3, p. 74 (1889); 14, pp. 000 (1901).

Wolff.—When corn silage was fed the total and digestible dry matters and the sundry nutrients were eaten in excess of requirement. Indeed several cows ate considerably more than standard amounts. Atalanta's eating, however, barely met standard needs and it was quite deficient when she ate pomace. The rations tended to be narrower than standard. The total dry matter eaten by the pomace fed cows was plentiful in amount.

Wolff-Lehmann.—The cows ate digestible dry matter and digestible ingredients in excess, often in considerable excess over standard. Total dry matter consumption, however, was frequently sub-standard. The rations were invariably narrower than the standard calls for. It is fair to assume that the cows had plentiful supplies of food in both rations.

RESULTS

The following table summarized from those at various points in the appendix shows the increase or decrease—expressed as percentages, total equalling 100—in dry matter eaten, in milk, total solids and fat given and of products per 100 pounds of dry matter eaten, when silage was fed in comparison with apple pomace; hay and more or less silage as roughages and mixed feed No. 1, as concentrate being fed throughout, nutritive ratios ranging—when corn silage was fed—from 1:4.5 to 1:5.5 and averaging 1:5.0.

SUMMARY OF DIFFERENCE TABLES, ETC. (APPENDIX VI (*b*) AND VII)

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Quality of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter						Ratio of fat to solids-not-fat
								In entire ration			In exper't'l ration			
								Milk	Total solids	Fat	Milk	Total solids	Fat	
Pomace (actual) ± silage (calc.)	− 5	−19	0	+1	+2	+1	+3	+ 7	+ 7	+ 9	+25	+26	+27	
Silage (actual) ± pomace (calc.)	+ 6	+27	0	−1	−2	−1	−2	− 6	− 7	− 8	−26	−27	−28	
270 days' feeding on pomace ± 270 days' feeding on silage	− 6	−20	+0	+1	+2	+1	+3	+ 7	+ 9	+ 9	+29	+30	+32	−3

RESUMÉ

1. Equal amounts of milk were made on each ration. Three per-

2. The cows gave somewhat better milk on pomace than on corn silage. The difference amounted to about 0.12 percent fat.

3. Seven percent more product was made to the unit of dry matter in the pomace ration than in the corn silage ration.

These results are in essential accord with last year's experience[1] when a little less but better milk was made on the pomace feeding than when corn silage was fed. No ill effects on milk or butter were observed either year although such have been reported by Mr. G. W. Allen of Essex Junction. It will undoubtedly be wise for feeders to use it cautiously at first.

FINANCIAL CONSIDERATIONS

In last year's trials with seven cows the corn silage ration produced butter, skimmilk and plant food in excess of that supplied by the pomace ration, the increase being worth $1.28. But it cost $2.93 more than did its rival. The pomace brought about a saving of nearly a cent a day per cow.

The financial outcome of the present year is shown below. It is even more favorable than that of last year. It is assumed for the purposes of comparison that apple pomace costs at the farm one dollar a ton. This sum would probably pay for hauling and ensiling but would not permit much to be paid for it at the mill.

The corn silage ration fed 270 days made no more milk and 3 percent less butter than did the pomace ration fed the same time. It cost, moreover, $3.78 more. It made less butter, the shortage being equivalent to $1.28 but it contained $1.59 worth more plant food. If the added manurial value of the silage ration be considered an offset to the extra six and a half pounds of salable butter made on the pomace feeding, the difference is in favor of the first named ration to the extent of 31 cents. Its added cost, however, causes a loss of $3.47, over a cent and a quarter a day. If the plant food is not considered, the loss is much greater for extra cost ($3.78) plus lessened yield (worth $1.28) gives a net loss of $5.06, which approaches two cents a day.

The money value of apple pomace may be figured out in another way. In the experiment under consideration the values allotted to the butter, to skimmilk and to two-thirds of the fertilizing ingredients in the experimental feeds, pomace and silage, were identical, being $59.14. Subtracting from this sum the estimated costs of the hay and grain, $36.98 and $37.32, leaves, as sums which may be used for purposes of comparison, $22.16 and $21.82.

[1] Vt. Sta. Rpt. 14, pp. 359-362 (1901).

The amounts of silage and pomace fed were, in the one case, 6570 pounds of silage, and, in the other, 2434 pounds of silage and 4152 pounds pomace. To remove the disturbing effect of the silage fed with the pomace $8.20 may be subtracted from $21.82[1]. A fair comparative (by no means an absolute) showing may then be made by proportion:

6570:2000::$22.16:x=$6.75. 4152:2000::$13.96:x=$6.73

$6.75:$6.73::100:100.

If the reasoning upon which this calculation is based is correct the feeding value of pomace is equal to that of silage.

In last year's trials the relation figured out in this manner was 100:84. From every standpoint, that of the cow as well as that of the pocketbook, apple pomace seems worth using. Let not a pound of it go to waste in this coming winter of shortage!

COMPARATIVE VALUES OF VARIOUS RATIONS FROM THE FINANCIAL STANDPOINT

RATIONS	Hay	Corn silage	Apple pomace silage	Wheat bran	½ cottonseed meal ½ linseed meal	Milk	Butter	Money value of food	Cost of food for 100 lbs. of milk	Cost of food for 1 lb. butter	Proceeds for butter at 20 cents	Fertilizing value of food eaten
	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	$	cts.	cts.	$	$
270 DAYS ON CORN SILAGE RATION VS. 270 DAYS ON APPLE POMACE SILAGE RATION												
Corn silage	3058	6570	----	1316	656	4080	237.5	46.91	115 0	19.8	47.50	34 36
Apple pomace silage	3125	2434	4152	1315	657	4086	243.9	43.13	105.6	17.7	48.78	32.77
Differences in favor of silage ration						+ 6	+ 6.4	— 3.78	— 9.4	— 2.1	+ 1.28	— 1.59
Percentage differences						0	+ 3	— 8	— 8	— 11	+ 3	— 5

Total value of butter, skimmilk and two-thirds of fertilizing ingredients; corn silage ration, $77.41; pomace silage ration, $77.64.

Difference in favor of pomace ration, $0.23.

Gain, ($0.23), plus lessened cost, ($3.78), gives net gain, $4.01; daily net gain, 1.49 cents.

[1] 2434 is 37 percent of 6570. 37 percent of $22.16 is $8.20. $22.16—$8.20 =$13.96.

108 DAYS ON POMACE RATION VS. 108 DAYS ON POMACE SILAGE RATION

Apple pomace silage (1)	1318	954	1296	504	252	1274	85.8	17.00	133 4	19.8	17.16	12.83
Apple pomace silage (2)	1249	964	1341	504	252	1282	85.9	16.71	130.3	19.5	17 18	12.63
Differences in favor of ration No. 2						+ 8	+ 0.1	− 0.29	− 3.1	− 0.3	+0.02	−0.20
Percentage differences						+ 1	0	− 2	− 2	− 2	0	− 2

. Total value of butter, skimmilk and two-thirds of fertilizing ingredients; pomace (1) ration, $27.90; pomace (2) ration, $27.80.

Difference in favor of pomace (1) ration, $0.10.

Gain, ($0.10), less extra cost, ($0.29), gives net loss $0.19; daily net loss, 0.18 cents.

VIII. EXPERIMENTAL ERROR

Publication on this subject is made simply with a view of placing on permanent record results attained incidentally in connection with the feeding trials of the past winter. The many tests hitherto made[1] and the entirely concordant results obtained have made further tests quite unnecessary.

Twenty-two cows were fed unchanging rations during the winter of 1901-1902. All but one of these were used in the trials which had to do primarily with the comparisons of methods (see succeeding article). If, however, their records be treated as if they were fed different rations in alternate periods a measure of the extent of experimental error is at hand. The large number of cows distributed among the sundry trials makes quite a formidable array of figures.

As may be imagined so large a number of cows included all sorts, old, middle aged and young, cows fresh, cows in mid-lactation and those far along towards calving. Those fed low grain rations sometimes ate less dry matter than standards called for, but practically all the others, when judged by either standard, ate as much as the law allowed or more, But whatever the eating, whether standard, sub-standard or super-standard, it was essentially uniform week in and week out.

RESULTS

The following table summarized from those at various points in the appendix shows the increase or decrease—expressed as percentages, total equaling 100—in dry matter eaten, in milk, total solids and fat given and of products per 100 pounds of dry matter eaten, both in the total ration and in the grain ration when unaltered rations consisting of hay and corn silage (apple pomace silage eaten by two cows instead of corn silage) as roughages and sundry mixed feeds as concentrates were fed throughout, nutritive ratios ranging widely among the 22 cows but for each cow remaining closely uniform.

[1] See footnote page 319.

SUMMARY OF DIFFERENCE TABLES, ETC. (APPENDIX VI (*b*) AND VII)

RATIONS	Dry matter	Dry matter in grain rations	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In grain ration: Milk	In grain ration: Total solids	In grain ration: Fat	Ratio of fat to solids-not-fat
Mixed feed No. 2; low grain ration	− 1	−2	+1	0	0	0	0	+ 1	+ 1	+ 1	+ 4	+ 3	+ 2	...
" " medium "	+ 1	0	+1	0	0	+1	0	0	0	− 1	+ 1	0	0	...
" " high "	+ 1	+2	0	0	0	0	0	− 1	− 2	− 1	− 2	− 2	− 1	...
" No. 3; low "	0	0	0	0	0	0	0	− 2	− 2	0	0	0	0	...
" " medium "	+ 1	+1	+1	0	−1	0	+1	0	− 2	− 2	0	0	− 1	...
" " high "	− 2	+3	+1	0	0	+1	+2	+ 2	+ 2	+ 3	− 2	− 1	− 2	...
" No. 1 medium "	+ 3	+4	0	0	−1	0	0	− 1	− 1	− 2	− 1	− 2	− 2	...
" " 4 " "	0	0	0	0	+2	0	+1	0	0	+ 1	0	0	+ 1	...
" " 5 " "	+ 2	+2	+1	+1	+1	+2	+2	− 1	− 1	0	− 1	− 1	0	...
Apple pomace silage	+ 2	+6	−2	0	+1	−1	−1	− 3	− 3	− 3	− 8	− 8	− 8	...
Mixed feed No. 2; 90 days on low ration ± 90 days on same	− 4	−1	−1	0	0	−1	−2	+ 2	+ 3	+ 2	+ 2	+ 1	− 1	+1
Mixed feed No. 2; 126 days on medium ration ± 126 days on same	+ 5	−1	+1	0	0	+1	+1	− 4	− 3	− 4	+ 2	+ 2	+ 1	0
Mixed feed No. 2; 126 days on high ration ± 126 days on same	+ 1	+3	+1	−1	−2	0	−1	− 1	− 2	− 2	− 2	− 3	− 4	+2
Mixed feed No. 3; 90 days on low ration ± 90 days on same	+ 6	0	+1	0	+1	+1	+2	− 4	− 4	− 3	+ 1	+ 1	+ 2	−3
Mixed feed No. 3; 144 days on medium ration ± 144 days on same	0	0	+2	0	0	+1	+1	0	0	− 1	+ 1	+ 1	0	0
Mixed feed No. 3; 54 days on high ration ± 54 days on same	− 1	+1	+1	+1	+2	+2	+4	+ 1	+ 1	+ 4	+ 1	+ 2	+ 4	−2
Mixed feed No. 4; 90 days on No. 4 ± 90 days on same	− 8	−7	−7	0	0	−7	−7	0	0	0	− 2	− 1	− 2	−1
Mixed feed No. 1; 90 days on No. 1 ± 90 days on same	− 5	0	−2	0	0	−2	−2	+ 3	+ 2	+ 2	− 2	− 2	− 2	+1
Mixed feed No. 5; 72 days on No. 5 ± 72 days on same	+ 4	+3	0	0	+1	0	+1	− 3	− 3	− 3	− 2	− 2	− 2	0
Apple pomace silage: 108 days on pomace ± 108 days on same	− 1	+4	+1	0	0	0	0	− 1	− 1	− 1	− 3	− 4	− 5	0

Twenty sets including 270 separate figures! These distribute as follows: zeros 84, ones 83, twos 57, threes 19, fours 14, fives to eights 13. Ninety percent are threes or less, and the average value is only 1.47. This is a good showing. Indeed 9 of the 13 fives (or higher) are located in two lines, the apple pomace silage and mixed feed No. 4, in both of which trials trouble occurred; and three of the remaining four are in the dry matter column in which variation might not unnatu-

rally occur. The comparison is a most excellent one, and once more, and with the largest number of figures thus far arrayed at this station, we affirm that if the selection of animals be made with care and a sufficient number is used, the experimental error factor may be practically disregarded when the alternation system of comparison is used.

IX. SUMMARY

The details given in the foregoing forty-three pages may be summarized under their respective reference numbers and headings as follows:

1. *The nature of the problems studied.*—Fifty cows were used in the feeding trials, which lasted 24 weeks and were meant to determine as far as it is possible for single trials to do:

(*a*) The effect on the quantity and quality of milk and on the economy of production, of low, medium and heavy grain feeding; also the limit of profit in the addition of grain to a ration—pages 284-300.

(*b*) The feeding value of malt sprouts compared with

(1) a mixture of cottonseed and linseed meals; and with

(2) ground oats—pages 300-305.

(c) The feeding value of dried brewers' grains compared with a mixture of cottonseed and linseed meals—pages 306-307.

(*d*) The feeding value of two King gluten meals, one relatively high, the other relatively low in protein—pages 307-309.

(*e*) The feeding value of apple pomace as compared with silage—pages 310-314.

(*f*) The extent of experimental error—pages 314-316.

2. *Methods, details, etc.*—The feeding periods were four weeks long and many different rations were used. Hay and silage were the only roughages used—except in the test designated *e*— and were fed to all the cows. Fifty-six cows were started in the experiments and the records of 50 were deemed safe to use. Full records were made, including weights of cows, fodders and feeds, milk, etc., barn temperatures were taken and constant analytical check was kept upon every phase of the work throughout the entire 24 weeks. These are in part exhibited on pages 282-283 and also in the appendix to this report.

3. *How much grain may be fed with profit to cows?* Twenty-four cows were fed with a view of determining whether 4 pounds of grain were to be preferred to 8 pounds, or 8 to 12 pounds daily. The outcome was essentially as follows:

Quantity.—The more grain, the more milk and butter; but the gains were not in proportion to the increase in feed, being two-thirds as great when 8 pounds of grain were fed instead of 4 and one-sixth as great when 12 pounds were substituted in lieu of 8 pounds.

Economy of production.—A pound of dry matter made more milk and butter when the low ration was fed than when the medium was used and, also, when the medium ration was fed instead of the heavy one.

Live weight.—About two-thirds of the cows responded to radical changes in ration by gaining or losing in flesh as feed was increased or lessened. Those uniformly fed about held their own.

Financial outcome.—At no time did the increase in grain over the basal amount of 4 pounds daily yield enough butter to meet the cost of the additional feed. More skimmilk and better manure were made when the medium ration was replaced by the low one, which, with the extra butter, barely compensated for its extra cost. The use of the high grain ration, however, entailed a very heavy loss if butter alone is regarded as an asset and a large loss even when the byproducts are reckoned in. In almost all cases the cows received, even when on the low ration, enough dry matter to meet the requirements of either the Wolff or the Wolff-Lehmann feeding standards.

The results do not favor the practice of heavy grain feeding when one has plentiful supplies of roughages. When, however, these are less liberally used or are less palatable than are early cut hay and mature, well eared silage, such procedure has greater promise. It is doubtful, moreover, whether in regular practice as low a daily grain ration as 4 pounds is advisable provided the cows are of the better class. The milk flow, live weight and constitutional vigor are more likely to be maintained on a liberal than on a stinted ration. It is felt on the whole that neither the low nor the high grain ration ranks with a medium one for practical, continuous dairy feeding. The outcome of this year's trials are in all respects a parallel to last season's and are in many ways akin to that of similar experiments recently reported by the Wisconsin station—pages 284-300.

4. *Feeding value of malt sprouts.*—Malt sprouts were not relished by the cows. Some refused to eat them dry or soaked. When fed in comparison with cottonseed and linseed meals dry matter consumption and milk yields each dropped a tenth. When fed in comparison with ground oats dry matter consumption dropped 9 percent and milk yields 4 percent. The quality of the milk was unchanged in either case. The production to a unit of dry matter was the same on the sprouts ration as on the cottonseed-linseed one and 5 per cent greater than on the oats ration. The cottonseed-linseed ration proved more economical than did the malt sprouts, the daily net gain per cow by its use being 1.93 cents, half in extra butter and half in extra skimmilk and manurial

constituents. The extreme and almost unprecedented high price of oats during the past winter made the financial showing very unfavorable to that ration—pages 300-305.

5. *The feeding value of dried brewers' grains.*—When dried brewers' grains were fed against cottonseed and linseed meal the results in quantity and quality of milk were essentially uniform. Since the brewers' grain ration cost 8 percent the less it came out ahead financially to the extent of 0.58 cents per cow daily—pages 306-307.

6. *The relative feeding values of low protein and of high protein King gluten meals.*—When a King gluten meal carrying 29 percent protein was fed in comparison with one containing 36 percent, as much and as good milk was made notwithstanding its inferior character. The financial outcome, however, favored the richer ration by a small amount, 0.17 cents per cow daily. The cows got enough to eat and, doubtless, enough protein on both rations; and "enough is as good as a feast"—pages 307-309.

7. *The feeding value of apple pomace.*—No more milk, but 3 percent more butter, 7 percent more to the unit of dry matter, and a somewhat better milk resulted from the feeding of apple pomace in the place of silage. It is far better worth a dollar a ton than is corn silage worth $3 a ton. Indeed a ton of pomace was found to have practically the same feeding value possessed by a ton of silage. Neither the cows nor their products were unfavorably affected by the use of the pomace —pages 310-314.

8. *Experimental error.*—The results of continuous feeding on a regular ration were uniform. If more than two or three animals are used the experimental error inherent in the alternation method of feeding trials may be quite disregarded, unless untoward accidents occur—pages 314-316.

A COMPARISON OF FEEDING TRIAL METHODS

The feeding trials of the past season were so planned as to afford an opportunity of repeating the comparison made during the previous year and discussed in the last report[1] as to the merits of the two methods most commonly used in conducting feeding trials with cows. It hardly need be said that accuracy is a prime essential in such trials. Yet it must be confessed that many men whose experience entitles them to pass judgment express lack of confidence in the trustworthiness of the results of the generality of feeding experiments and in the soundness of the deductions drawn therefrom.

There are several reasons for this incredulity, reasons into which it is not at present necessary to enter. Undoubtedly a prime cause of dis-

[1] Pages 369-375.

trust has been the common feeling that the methods of measurement in use were faulty. This station, in its feeding work for some years back, has had it in view to examine these methods, to endeavor if possible to improve upon them, to measure, as it were, the means of measurement, and to determine their validity. As contributions towards this end may be cited the studies of the proper lengths of feeding periods[1] and of the extent of experimental error inherent in the use of alternating periods,[2] as well as the article in last year's report already cited. Whether the results of this line of work are positive or negative, constructive or destructive, whether they make for betterment or simply reveal weaknesses, they ought to prove of service. Feeding trials can never yield results as exact as those obtained in laboratory work; but they may furnish data accurate enough for practical purposes; and it is conceivable that this likelihood may be enhanced by the disclosure of defects or the affirmation of soundness.

As a further contribution in this line are offered the results of a second year's comparative trial of the feeding methods denominated last year as the alternating and the combined continuous and alternating systems.

Without reiterating the comments made upon these methods last year, it may be well to state that these terms are applied, the one to trials in which competitive rations are fed to the same animals in alternate periods, and the other to trials in which the animals are divided into groups, one of which is fed continuously on one ration, while the other is fed in alternate periods on two rations, one of which is the same as that fed the animals in the other group.

In planning the feeding experiments of 1901-1902, it was designed to measure the relative values of low, medium and heavy grain feeding, the comparative merits of mixed feeds 1 and 4, of mixed feeds 4 and 5, and of corn silage and apple pomace silage by two methods, that of alternation and that of combined continuity and alternation. Forty-eight cows were chosen for these tests, twenty-four of which were to be fed different rations alternately while twenty-four were destined to eat continuously a uniform ration. In other words, these cows, one from each set, were paired one against another in twenty-four "couples."

Several of these couples, for one reason and another, fell by the wayside. The dereliction of either member of a pair in trials of this kind renders the records of both unserviceable. Shrinkage prepara-

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[1] See Vt. Sta. Rpts. 10, pp. 146-161 (1897), 11, pp. 320-330 (1898), upon the relation of the length of the feeding period to the reliability of results.

[2] Vt. Sta. Rpts., 3. pp. 62-64 (1899) ; 9, pp. 225-228 (1895) ; 10 pp. 165-167 (1897) ; 11, pp. 339-340 (1898) ; 12, pp. 286-287 (1899) ; 14, pp. 365-366 (1901), also this report, pp. 314-316.

tory to drying off and too late calving spoiled five sets, errors in feeding made two useless, the refusal to eat malt sprouts forced two sets apart (but permitted the recoupling in a good match of what might be termed the survivors), and a faulty plan made one record worthless. Thus but 15 sets survived. This outcome illustrates very well the point made in last year's report touching the very serious effect that the eccentricities of single cows have on results sought by the combined method.

The following table shows something of the condition of these 30 cows as regards time from calving, time to next calving, and live weight at the opening of the trials. It also shows the yields of milk, total solids and fat and the quality of the milk given during the experimental portion of the first period when both members of the couple were similarly fed. The cow first named in each couple was fed continuously the ration indicated at the right hand of the tabular matter. Her mate alternated on the two rations there mentioned. It may be remarked that the coupling was made with care, choices being based on a survey of past records, the condition of the animals, their yields at the opening of the trials and the probabilities for the succeeding months. Naturally all the probabilities did not become actualities. Nos. V, VI, IX, X, XII, XIII, and XIV proved to be fairly satisfactory matches; and all but one was expected to be such at the outset. Nos. I, II, IV, and VII were at best but fair, although the first three promised well in the fall. Nos. III, VIII, XI, and XV were positively bad matches, and Nos. XI and XV were realized to be such when they were mated, but it was the best that could be done. Twenty-seven of the cows were grade Jerseys and three registered Jerseys.

TABULAR STATEMENT SHOWING COWS USED IN COMPARATIVE TRIALS OF METHODS

Reference number	NAME	Age	Days since calving	Approximate number of months to next calving	Weight at beginning	Milk	Total solids	Fat	Total solids	Fat	Nature of ration or rations
					lbs.	lbs.	%	%	lbs.	lbs.	
I	Buttercup	5	263	Farrow	1043	284.5	17.22	6.66	48.99	18.94	Low
	Goldenrod	10	214	8	1064	206.8	17.85	7.50	36.91	15 51	Low and medium
II	Stella	..	3	11	832	418.1	14.30	4.60	74.09	23.83	Medium
	Viola	5	11	12	846	387.6	15.60	5.76	60.45	22.32	Medium and low
III	Claire	14	77	Farrow	993	465.1	14.00	4.73	65.14	22.02	Medium
	Adelaide	8	115	12+	920	308.6	14.89	5.33	45.96	16.45	Medium and high
IV	Lucerne	8	30	10	822	439.6	15.28	5.39	67.16	23.67	High
	Max Belle	9	106	11	906	321.5	15.94	5.86	51.24	18.85	Medium and high
V	Rosemary	7	9	12	857	514.4	13.78	4.44	70.86	22.81	High
	Serena	5	29	11	823	414.1	13.85	4.41	57.35	18.27	Medium and high
VI	Santa Rosa	..	219	7	722	276.8	14.25	4.67	39.45	12.93	Low
	Fresno	..	22	12†	835	346.8	13.93	4.47	48.30	15.51	Low and medium
VII	Mermaid	6	17	..	847	513.4	13.91	4.57	71.42	23.47	Low
	Eva	9	62	12	865	359.4	15.07	5.39	54.17	19.36	Low and medium
VIII	Pauline	6	..	Farrow	913	307.6	15.49	5.32	47.64	16.37	Medium
	Pretoria	5	98	10	852	208.1	13.84	4.54	28.80	9.44	Low and medium
IX	Pomona	10	7	11	862	444.5	14.17	4.92	62.92	21.87	Medium
	Inez	9	27	10	840	424.2	14.96	5.32	63.46	22.58	Medium and high
X	Powella	..	211	3	862	275.4	17.17	6.67	47.29	18.37	High
	Lady Per'ia	8	238	11	1092	224.0	17.28	6.79	38.49	15.21	Medium and high
XI	Ceres	11	17	11	889	572.0	14.26	4.79	81.63	27.39	High
	Red Top	12	103	Farrow	1040	349.9	13.18	4.24	46.13	14.82	Medium and high
XII	Fairie	12	181	8	866	279.0	15.12	5.39	42.19	15.03	Mixed feed 4
	Flora	12	231	8	960	296 9	14.71	5.26	43.67	15.61	Mixed feeds 1 & 4
XIII	Edith	4	91	12†	748	318.1	14.95	5.16	47.56	16.43	Mixed feed 1
	Sadie	4	9	12†	818	364.8	14.34	4.91	52.32	17.92	Mixed feeds 1 & 4
XIV	Primrose	9	30	12	913	343.7	13.79	4.39	47 39	15.08	Mixed feed 5
	Naomi	6	11	12†	793	308.3	14.07	4.28	43.37	13.18	Mixed feeds 4 & 5
XV	Hallowe'en	8	3	12†	848	408.2	14.47	4.80	59.07	19.57	Mixed feed 5
	Dorothy	..	9	12†	727	226.8	14.26	4.73	32.34	10.73	Mixed feeds 4 & 5

The plan of experimental feeding, the comparison with standards and the general results were discussed in the previous article. It simply remains, therefore, for us to consider the final results as measured by the two methods of experimentation.

Last year's report contained a table showing the percentage differences[1] in the dry matter consumption, in the quality of the milk, in the production of milk, total solids and fat and in the production of the same per unit of dry matter. It showed this for both sets of cows, the animal first named in each case having been fed continuously on one ration and the one second named having been alternated between rations. It likewise gave the results following a change in the ration fed, as for instance a change from the low to the medium feeding. These form the measure of the value of the rations.

This table if made this year would cover two pages solidly with figures. It is thought that it would be quite as well simply to give one example of the determination of the effect of a ration by the combined method and to deal in a later tabulation solely with the averages.

TABULAR STATEMENT SHOWING PERCENTAGE DIFFERENCES IN COMPARATIVE TRIALS IN THE PRODUCTS OF THE COWS. BUTTERCUP (CONTINUOUSLY FED ONE (LOW) RATION) AND GOLDENROD (ALTERNATELY FED TWO (LOW AND MEDIUM) RATIONS)

Showing the increase or decrease, as the case may be, of the records of each cow in period 3 as compared with the average of the records of periods 2 and 4	Number of period of comparison	Total dry matter	Milk	Percentage of total solids	Percentage of fat	Total solids	Fat	Product per 100 pounds of dry matter		
								Milk	Total solids	Fat
Buttercup, uniform feeding on low ration	....	+ 6	+ 2	− 1	0	0	+ 2	− 4	− 6	− 4
Goldenrod, period 3, medium ration; 2 and 4 low ration	....	+22	+ 8	+ 1	+ 4	+10	+12	−12	−11	− 9
Result (±) of increase of ration as measured by Goldenrod's record in comparison with Buttercup's	....	+16	+ 6	+ 2	+ 4	+10	+10	− 8	− 5	− 5

The following explanation may serve to make this table and its meaning more clear. The cows Buttercup and Goldenrod at the opening of the trials in December gave promise of making much the same amounts of milk and butter, and of making milk of essentially uniform character during the next six months, provided they were similarly treated and fed. Buttercup was thus handled, being fed a uniform low grain ration for 24 weeks. Goldenrod, however, was not, since she alternated from a relatively low to a medium diet and back again. In the third period Buttercup made 2 percent more milk than she did

[1] For further explanation of this phrase and of the meaning of the figures see note on page 287 and explanatory note to table VII at the end of the appendix.

on the average in the second and fourth periods on the unchanged ration. But Goldenrod made 8 percent more at the same time, due presumedly to her increased grain ration. It is fair to assume that her milk flow would have increased but 2 percent (and perhaps not at all), had she, like her mate, been restricted in her diet. Hence +6 (or 6 percent of a total which equals 100) is the measure, in this particular case, of the effect of the increased grain ration on the milk flow. All the other items, the quality of the milk, the pounds of total solids and fat, and the same proportioned to the unit of dry matter are similarly calculated. These plus and minus changes, gains and losses, as a result of varying rations, are the measures of the worth of two rations by the combined method of continuity and alternation.

These comparisons can only be made when the cow alternately fed varying rations eats the same one as her mate in the first and last period under comparison and the other ration in the intermediate period. This limits the number of observations to, at best, two for each couple and, in the majority of cases, to but one. Twenty-one comparisons only can be made, 16 in the low, medium and high grain feeding trials, and 5 in the malt sprouts experiments.

Now the question arises how do these twenty-one results arrived at by the combined continuous-alternating method compare with those obtained by the alternation system? The data secured by the latter are given on pages 288, 302 and 303 in connection with the previous article. The following table shows them condensed and compared with those derived in the manner just indicated by the combined system. The horizontal lines marked "differences" serve to show what divergencies occur.

TABULATED STATEMENT COMPARING THE TWO METHODS

Reference number	Method employed	Changes from to	Number of observations or records	Total dry matter eaten	Quantity of milk	Total solids, percent	Fat, percent	Quantity of total solids	Quantity of fat	Products per 100 pounds of dry matter: Milk	Total solids	Fat
I	Continuous-alternation	Low to medium	9	+17	+10	+ 1	+ 1	+11	+12	− 7	− 7	− 6
	Alternation	" " "	4	+17	+14	0	0	+15	+14	− 2	− 1	− 2
	Differences			*0*	4	*1*	*1*	4	*2*	5	6	4
II	Continuous-alternation	Medium to low	10	−13	−11	− 1	− 2	−12	−13	+ 3	+ 2	+ 2
	Alternation	" " "	4	−12	− 6	− 1	− 2	− 7	− 8	+ 6	+ 5	+ 4
	Differences			*1*	5	*0*	*0*	5	5	*3*	*3*	*2*
III	Continuous-alternation	Medium to high	11	+10	+ 1	0	0	+ 1	+ 2	− 7	− 8	− 8
	Alternation	" " "	3	+11	+ 1	− 1	0	0	+ 1	−10	−11	−10
	Differences			*1*	*0*	*1*	*0*	*1*	*1*	*3*	*3*	*2*
IV	Continuous-alternation	High to medium	10	− 9	− 2	+ 1	+ 1	− 2	− 2	+ 8	+ 8	+ 9
	Alternation	" " "	5	− 9	− 2	+ 1	0	− 1	− 1	+ 9	+ 9	+ 9
	Differences			*0*	*0*	*0*	*1*	*1*	*1*	*1*	*1*	*0*
V	Continuous-alternation	Nos. 4 and 1	3	+12	+15	0	+ 1	+15	+16	+ 3	+ 3	+ 3
	Alternation	" "	1	+ 6	+27	− 2	− 1	+24	+25	+18	+15	+16
	Differences			6	12	*2*	*2*	9	9	15	12	13
VI	Continuous-alternation	Nos. 1 and 4	4	−12	−11	+ 1	0	−10	−11	+ 2	+ 2	+ 1
	Alternation	" "	2	− 6	− 7	+ 1	− 1	− 7	− 7	− 1	+ 1	− 1
	Differences			6	4	*0*	*1*	*3*	4	*3*	*1*	*2*
VII	Continuous-alternation	Nos. 4 and 5	3	− 8	− 3	0	− 1	− 4	− 4	+ 6	+ 4	+ 3
	Alternation	" "	2	−12	− 5	− 1	− 2	− 6	− 7	+ 8	+ 6	+ 6
	Differences			4	*2*	*1*	*1*	*2*	*3*	*2*	*2*	*3*

Naturally zeros and ones are all that can be desired. Twos are quite satisfactory and indicate fair agreement. Threes are rather wide, while fours and larger figures mean serious differences. These large figures occur often in the table, 27 out of 63 being threes or greater. Eliminating comparison V,—which really ought not to be counted, but which is included for a purpose,—20 out of 54 comparisons or over one-third of the entire number are beyond the pale. What is the explanation of these wide divergencies? Which, if, indeed, either, of these methods may be relied upon?

Let us analyse the figures in sets I, II, V, VI, and VII, referring, as needed, to the condensed records of the appendix.

I. Two disturbing factors are at fault which serve to increase the size of the plus and decrease those of the minus figures in the upper line. Goldenrod, in passing from a medium to a low ration at the end of the trials, shrunk heavily in her milk yield. Her six successive period yields are 254, 207, 215, 190, 214, 155 pounds. This shrinkage naturally affected all the data except that of dry matter eaten and the

quality of the milk. A short off-feed turn of Fresno's, early in the second period, seems to have had some slight influence in the same direction. It should be said, however, that even though Goldenrod's record be eliminated the comparison is a poor one.

II. The differences observed in this case are due solely to the strange performance of the cow Pretoria. Her milk yield decreased from period to period with the utmost regularity, quite regardless of her passage from a low to a medium grain ration and back again. The silage fed in the second period had a very low and that in the third an extremely high dry matter content. This occurrence served, with this cow, largely to neutralize the effect of the change in the grain ration. Pretoria's record on diverse feeding is more uniform than is her mate's when fed on an unchanged ration; hence when it is used therewith in the manner contemplated by the combined method of continuity and alternation, it naturally affords anomalous results. The record is out of the common when used according to the alternation system: but its eccentricities are not accentuated as they are in the other case and it furnishes but one-fifth instead of one-half of the data from which averages are made. If the Pauline-Pretoria couple is omitted the comparison of the results by the two methods becomes all that could be desired and consists of zeros and ones.

V. This comparison is included simply to show the possibilities for error of the combined method when the number of observations is limited. The only data available was Flora's record on mixed feeds 4 and 1 compared with Fairie's on No. 4 for the second, third and fourth periods. Flora ate No. 4 with reluctance, fell off a sixth in total dry matter eaten, and shrunk heavily in milk yield whenever this feed was used. A serious shrinkage in the fourth period makes her record entirely useless for a comparison of this kind.

VI. The differences in this case are due to the fact that Edith, uniformly fed mixed feed 1, ate a good deal more dry matter and made quite a little more milk in the odd numbered than in the even numbered periods. This affected results in one direction in each of the two comparisons from which the upper line of figures is derived. Edith does not contribute to the data on the other side; hence the discrepancies.

VII. The two threes in this comparison are really twos and a half and are due to an accumulation of fractions. The four is a consequence of Naomi's dislike for mixed feed 4, which caused a drop in the dry matter consumption in the only period when, by the combined method, her data is of use.

The extremely high dry matter content of the silage fed during February bred trouble. Many results were slightly and some consid-

erably altered by this occurrence, and undoubtedly the force of some of the deductions is weakened thereby. In the particular matter now under discussion, the comparison of feeding trial methods, this fluctuation in food value has proved particularly annoying. Oddly enough the bad matches do not seem to have materially affected results, except perhaps in the case of couple I in the first comparison.

All the apologies having been made, what is now to be said of the outcome? Discarding V for the reasons stated, and accepting as valid the excuses given above, we may consider II (with the Pauline-Pretoria couple eliminated), III and IV good, VII not bad (nor is it good), and I and VI poor, VI with reason and I without. Three out of four comparisons were satisfactory in last year's trials; but this year but one-half at best are good, a third are positively bad and a sixth indifferent. The showing is not a favorable one; and the question arises which party is guilty? Are the results of either method of measurement trustworthy? If so, which?

It was stated in last year's report that "so far as the trials go they seem to affirm within limits the validity of both schemes of experimentation, provided periods four or five weeks long be used and the choice of animals be satisfactory." So optimistic a statement cannot be made this year.

It is the writer's judgment that the faults are mainly located in the combined method, and that the deductions which may be drawn from the results afforded by the plain alternation system, imperfect though it is, are less likely to be open to error than are those predicated on the data furnished by the former method. As has been pointed out hitherto, the combined continuity and alternation system possesses all the faults of the alternation method as well as some peculiarly its own. The number of observations are seriously curtailed, the individualities of two animals instead of one have to be reckoned with, and the eccentricities of either affects the record of both. A deduction based on agreeing data obtained by both methods of trial is much strengthened over that drawn from the results afforded by either alone; but in the event of a lack of substantial unanimity, if inexplicable, the writer, with his faith in the credibility of the outcome somewhat shaken, would feel inclined to trust the data arrived at by alternation rather than that furnished by the combined method, providing the feeding periods were four, five or six weeks long and the choice of cows satisfactory.

This year's trials were planned on a more extensive scale than were those of the previous season, and, it was thought, with greater care. Yet the outcome illustrates anew the old saying as to the fate of the cautious plans of mice and men. However, believing that the

question of the validity of the current methods for the conduct of feeding trials is one of fundamental importance, and realizing that the equipment of this station is in many ways peculiarly well adapted to work of this character, it is the writer's intention to pursue this line of inquiry for some time to come in the hopes of arriving at more definite and satisfactory results.

RECORDS OF THE STATION HERD FOR 1900-1901 AND FOR 1901-1902.

Records have been kept of the dairy performances of each cow in the station herd from its establishment in 1888 to date. For many years these records have been tabulated and commented upon in the station publications.[1] It is expected to continue this work and at some time to collate the vast amount of data thus collected. This time has not as yet, however, arrived.

The records appearing on the next few pages include for each cow the production of milk, total solids, fat and butter, the cost of the food eaten to the 100 pounds of milk and to the pound of fat and butter, the cost of the total food eaten, of the purchased grain, the net proceeds from butter sales—at the average price actually received during the year for butter—and the value of the fertilizing ingredients in the fodders and feed eaten.

The average production of milk and of butter for the entire herd during the past ten years has been quite satisfactory and fairly uniform. The butter productions have been as follows: 1892, 335 pounds; 1893, 330 pounds; 1894, no record; 1895, 325 pounds; 1896, 324 pounds; 1897, 338 pounds; 1898, 313 pounds; 1899, 320 pounds; 1900, 357 pounds; 1901, 343 pounds; 1902, 308 pounds. The herd of 1892-93 contained about twenty cows and was slaughtered early in 1894 because of tuberculosis. The animals included in the present herd were bought (or raised) at various times from 1894 to date.

There were 61 cows in the herd within the limits of the first, and 68 cows in the second record year[2] but only 45 and 49 were members throughout the two years. Some of the cows not figuring in the main tabulation were heifers with their first calves, some were sold for beef and some were purchased. The records of such cows as failed to complete a record year have been kept as carefully as have those of the others. These broken records have not the value that pertains to complete data, yet since several of these cows have figured in past

[1] Vt. Sta. Bul. 33 (1893); Rpts. 6, pp. 119-121 (1892); 7, pp. 82-83 (1893); 9, pp. 187-192 (1895); 10, pp. 181-188 (1897); 11, pp. 355-365 (1898); 12, pp. 299-307 (1899); 13, pp. 445-460 (1900).

[2] Nov. 1 to Oct. 31 constitutes a record year.

records and some of them will appear in future ones, the data is published on the pages immediately succeeding the main tables.

The animals whose names are italicized in the tables are registered Ayrshires, those in black face, registered Jerseys. All others are high grade Jerseys. Many of the animals have higher records in past years than those given in the present tabulations.

The remarks on this and the succeeding pages are explanatory of the record tables of the two years.

"*Pounds of milk*" are obtained by weighing each milking of each cow throughout the year.

"*Percent of fat*" is obtained by averaging by cross-division. Composite samples—eight or nine milkings each—are taken of the milk of each cow bi-monthly throughout the year and constantly while on feeding experiment.

"*Pounds of butter*" are obtained by adding the usual factor, *one-sixth*, to the pounds of fat. This is equivalent to a "surplus" of 16.7 percent. The conditions of our work (much sampling, varying methods of handling, frequent handling of relatively small quantities, etc.) are such that the average "surplus" is seldom thus high. Much cream and some milk are sold, and large amounts are taken as samples; hence the exact make all as butter cannot be stated. Careful estimates of the butter values of these sold and sampled products, added to the known butter sales, when compared with the results of calculations using the one-sixth factor, have in years past agreed within a narrow margin and shown a surplus of from 12 to 14 percent. It is manifestly unfair to charge against the cows these losses of butter which to a considerable extent are caused by the peculiar nature of our work and which do not obtain in ordinary dairy management.

"*Cost of food*" is reckoned from prices paid for grain—corn-meal, bran, cottonseed meal, linseed meal, Buffalo gluten feed, buckwheat middlings, Quaker oat or dairy feed, while hay, silage, soiling crops, are rated $3; and pasturage for the season at $5 per animal.

The average cost of food for 100 pounds of milk and for a pound of butter as stated in the table is obtained by dividing the total by 45 or by 49 thus giving to each cow the same value in the average, be she good, bad or indifferent. *As a herd* the average cost of food for 100 pounds of *herd* milk and for a pound of butter were considerably less than those stated in the tables.

The figures showing "cost of 100 pounds of milk" and "cost of one pound of butter" include only the cost of food as laid down in barn ready for feeding. They do not include the cost of feeding, caring for cows, making and marketing butter, depreciation of plant, interest on investment, etc.

HERD RECORD. NOV. 1, 1900-OCT. 31, 1901

Cow	Age November 1, 1900	Calved, 1900	Calved, 1901	Days in milk	Milk	Total solids	Fat	Total solids	Fat	Butter
					lbs	%	%	lbs	lbs	lbs.
Acme	11	Dec. 22	Mar.25'02	314	8682	11.81	3.57	1025.4	310.1	361.9
Adelaide	7	In fall	Aug. 14	333	5651	14.80	5.29	836.1	298.8	348.7
Atalanta	11	July 20	Aug. 4*	365	7494	12.08	3.96	964.9	296.6	346.1
Beautina of Hillcrest	9	Dec. 31	Feb.11 '02	321	6513	14.21	4.94	925.6	321.5	375.2
Buttercup	4	Farrow	Mar. 19	316	5733	15.60	5.79	894.2	331.9	387.3
Ceres	10	Nov. 22	Jan. 15 '02	344	8343	14.55	5.22	1213.9	435.9	508.7
Clare	13	June 4	Sept. 22	304	4542	14.52	5.04	659 5	228.8	267.0
Dahlia	9	Dec. 27	Mar.13'02	353	3973	15.24	5.72	605.6	227.3	265.3
Edith	3	July 24	Sept. 8	318	3915	14.82	5.34	580.3	208.9	243.8
Eunice	3	Aug. 13	Aug. 31	327	5292	14.70	5.04	777.9	266.9	311.5
Eva	8	Nov. 2	Dec. 31	359	7333	15.99	6.23	1172.0	456.6	532.8
Fairie	11	June 5	June 9	330	6347	13.98	4.76	887.3	302.1	352.5
Flora	11	Feb. 8	Apr. 21	291	6567	13.45	4.55	883.4	298.7	348.6
Goldenrod	9	May 31	May 7	306	4901	16.09	6.28	788.3	307.8	359.2
Haidee	4	Jan. 19 '01	Feb. 3 '02	297	6157	14.74	5.34	907.5	328.9	383.7
Hallowe'en	7	Nov. 5	Mar. 1 '02	358	6750	14.69	5.26	991.3	355.1	414.4
Idarella	10	Apr.23 '99	Mar. 19	281	3758	14.02	4.91	526.7	184.4	215.2
Inez	8	Jan. 1 '01	Jan. 4 '02	329	5730	14.43	5.72	826.6	327.5	382.2
Lady Perusia	7	Feb. 6	Apr. 14	330	4954	15.52	6.01	769.0	297.7	347.4
Lavender	3	In fall	Farrow	365	6227	15.06	5.59	937.8	347.9	406.0
Lilac	4	Mar. 26	Apr. 22	321	4809	14.27	4.76	686.2	228.8	267.0
Lucerne	7	In fall	Nov. 7	332	5586	15.69	5 92	876.3	330.8	386.0
Max Belle	8	July 30	Aug. 23	334	4956	15.45	5.71	765.6	282.8	330.0
Max Ella	9	Dec. 12	Jan.12 '02	342	7726	14.01	4.73	1082.1	365.5	426.5
Mermaid	5	In fall	Feb.11 '02	365	6604	16.09	6 29	1062.8	415.2	484.5
Minta Bella	9	Feb. 14	Feb. 24	309	6162	14.99	5.62	923.7	346.4	404.3
Mona	4	May 30	May 27	343	6475	14.53	5.07	940.7	328.3	383.1
Nan	3	July 14	Sept. 15	357	4373	14.64	5.19	640.3	226.9	264.8
Nancy B	13	Nov. 27	Apr.25 '02	339	9161	12.34	3.74	1130.0	342.3	399.5
Naomi	5	Dec. 21	Dec. 26	329	6193	14.20	4.71	879.3	291.5	340.2
Orpha	8	Oct. 5	Apr. 6 '02	365	7372	14.40	4.71	1061.5	347.1	405.1
Pauline	5	Apr. 5 '01	Farrow	308	6033	14.46	5.03	872.1	303.4	354.0
Phyllis	2	Nov. 1	Oct. 25	283	4782	13.95	4.41	667.0	210.7	245.9
Polela	6	Jan. 22	Jan. 7	157	4249	14.64	5.09	622.2	216.1	252.2
Pomona	9	Jan. 6 '01	Dec. 28	325	6252	14.78	5.43	924.3	339.2	395.8
Powella	8	May10 '01	Mar.12'02	360	5218	16.18	6.34	844.0	330.6	385.8
Pretoria	4	Farrow	Sept. 1	360	4563	14.53	5.0	663.0	228.4	266.5
Primrose	8	Nov. 4	Dec. 6	357	5259	14.00	4.77	736.1	250.7	292.6
Red Top	11	June 1	Aug. 27	289	5040	13.03	4.20	656.6	211.9	247.3
Rosel	4	In fall	Farrow	365	10525	12.76	4.25	1343.2	447.6	522.4
Rosemary	6	Dec. 19	Dec. 25	281	5260	14.15	4 77	744.4	250.7	292.6
Sadie	3	May 22	Nov. 28	226	1884	14.61	5.31	275.3	100.0	116.7
Serena	4	Jan. 4 '01	Dec. 8	329	4995	14.27	4.81	712.6	240.3	280.4
Star Bright	4	Dec. 24	Jan. 2 '02	314	6058	15.15	5 51	917.8	333.8	389.5
Stella	3	In fall	Jan. 7 '02	363	5277	14.45	4.92	762.6	259 5	302.8
Sylvia	9	July 9	Farrow	365	5541	14.80	4.96	820.0	274.7	320.6
Viola	4	Jan. 6' 01	Dec. 24	314	4004	14.76	5.29	590.9	211.8	247 2
Average				325	5814	14.41	5.07	837.7	294.6	343.8

*Aborted.

HERD RECORD. NOV. 1, 1900-OCT. 31, 1901

Cow	Total cost of food purchased	Total cost of purchased grain	Cost of food for 100 pounds of milk	Cost of food for 1 pound of fat	Cost of food for 1 pound of butter	Proceeds from butter sales at 27½ cents per pound	Value of fertilizing ingredients
	$	$	cts.	cts.	cts.	$	$
Acme	52.11	23.66	60.0	16.8	14.4	99.52	32.05
Adelaide	50.34	20 90	89.1	16.8	14.4	95.90	27.01
Atalanta	57.17	27.96	76.3	19.2	16.5	95.18	35.37
Beautina of Hillcrest	56.98	24.57	87.5	17.7	15.1	103.18	35.35
Buttercup	52.58	18.73	91.7	15.8	13.6	106.50	30.27
Ceres	53.01	24.84	63.5	12.2	10.4	139.85	32.63
Clare	47.12	21.65	103.8	20.6	17.6	73.42	29.17
Dahlia	46.72	18.76	117.6	20.6	17.6	72.96	28.34
Edith	42.91	17.54	109.6	20.5	17.6	67.04	26.42
Eunice	40.01	13 07	75.6	15.0	12.8	85.66	22.46
Eva	55.65	24.39	75.9	12.2	10.4	146.51	31.58
Fairie	47.37	20.20	74.6	15.7	13.4	96.94	28.40
Flora	47.31	17.35	72.0	15.8	13.6	95.86	27.85
Goldenrod	54.46	20.36	111.1	17.7	15.2	98.78	33.31
Haidee	51.01	19.76	82.8	15.5	13.3	105.51	30.92
Hallowe'en	56.58	25.64	83.8	15.9	13.7	113.96	35.36
Idarella	46.41	15.00	123.5	25.2	21.6	59.18	27.34
Inez	50.28	20.47	87.8	15.3	13.2	105.10	30.95
Lady Perusia	49.74	18.79	100.4	16.7	14.3	95.54	29.74
Lavender	55.21	24.06	88.7	15.9	13.6	111.65	34.08
Lilac	49.61	20.26	103.2	21.7	18.6	73.42	30.11
Lucerne	49.21	19.54	88.1	14.9	12.7	106.15	27.74
Max Belle	47.20	20.98	95.3	16 7	14.3	90.76	26.20
Max Ella	50.84	20.17	65.8	13 9	11.9	117.29	28.74
Mermaid	52.22	20.36	79.1	12.6	10.8	133.23	3 .74
Minta Bella	49.10	17.72	79.7	14.2	12.1	111.19	29.42
Mona	52.89	16.94	81.7	16.1	13.8	105.35	32,22
Nan	43.41	15 07	99.3	19.1	16.4	72.82	25.88
Nancy B	65.77	30.94	71.8	19.2	16.5	109.37	47.02
Naomi	47.32	17.27	76.4	16.2	13.9	93.55	26.83
Orpha	54.44	24.80	73.9	15.7	13.4	111.40	33.42
Pauline	49 81	19.46	82.6	16.4	14.1	97.36	29.54
Phyllis	39.27	15.06	82.2	18.6	16.0	67.62	23.84
Polela	37.86	12.21	89.1	17.5	15.0	69.36	23 34
Pomona	49.61	19.15	79.4	14.6	12.5	108.85	29.28
Powella	50.00	23.29	95.8	15.1	13.0	106.09	27.74
Pretoria	49.94	22 69	109.5	21.8	18.7	73 29	30 66
Primrose	54.07	23.44	102.8	21.5	18.4	80.46	34.03
Red Top	49.78	19.61	98.8	23.5	20.2	68.01	27.95
Rosel	60.23	26.74	57.2	13.4	11.5	143.66	35.28
Rosemary	45.36	17.51	86.2	18.1	15.5	80.47	27.02
Sadie	34.32	12.47	182.2	34.3	29.4	32.09	20.66
Serena	44.17	16.08	88.7	18.4	15.7	77.11	25.07
Star Bright	52.78	20.59	87.1	15.8	13.6	107.11	31.25
Stella	50.77	21.73	96.2	19.5	16.8	84.27	28.42
Sylvia	57.28	22.70	103.4	20.8	17.8	88.16	35.68
Viola	48.05	17.10	120.0	22.7	19.5	67.98	27.43
Average	49.97	20.25	90.4	17.7	15.2	94.56	29.81

HERD RECORD. NOV. 1, 1901-OCT. 31, 1902

Cow	Age November 1, 1901	Calved 1901-02	Days in milk	Milk	Total solids	Fat	Total solids	Fat	Butter
				lbs.	%	%	lbs.	lbs.	lbs.
Acme 5th	12	Mar. 25	307	7225	11.82	3.63	854.3	262.1	305.8
Adelaide	8	Aug. 14	365	5241	14.14	5.21	741.1	273.1	318.6
Atalanta	12	Aug. 4*	269	4859	12.55	3.81	609.8	185.0	215.9
Beautina of Hillcrest	10	Feb. 11	297	5838	14.00	4.82	817.5	281.3	328.2
Bertha	3	Apr. 9	300	4904	14.66	5.11	719.1	250.4	292.2
Buttercup	5	Mch. 19	365	4515	17.10	6.77	771.9	305.5	356.4
Ceres	11	Jan. 15	296	6958	14.52	5.15	1010.4	358.5	418.3
Clare	14	Sept. 22	365	7074	13.98	4.80	988.9	339.8	396.5
Dahlia	10	Mar. 13	328	3974	14.94	5.56	593.6	221.c	257.9
Edith	4	Sept. 8	365	5567	15.01	5.37	835.2	298.8	348.6
Eunice	4	Aug. 31	289	3499	14.80	5.19	517.9	181.6	211.9
Eva	9	Dec. 31	312	5938	15.47	5.82	918.8	345.6	403.2
Fairie	12	Sept.12'02	315	4585	14.73	5.20	675.4	238.4	278.2
Flora	12	July 25'02	274	4973	14.17	4.91	704.8	244.3	285.0
Fresno	3	Nov. 15	348	5933	13.76	4.44	816.0	263.3	307.2
Goldenrod	10	July 31'02	323	4482	16.31	6.45	731.0	289.3	337.5
Haidee	5	Feb. 4	304	6016	14.91	5.33	897.4	320.9	374.4
Hallowe'en	8	Feb. 28	321	5122	14.69	5.27	752.5	270.1	315.1
Idarella	11	Apr. 13	292	3247	13.87	4.81	450.4	156.1	182.1
Inez	9	Jan. 4	307	5150	14.92	5.45	768.4	280.8	327.6
Jersey Lily 2nd	2	May 27	365	2998	16 94	6.85	508.0	205.4	239.7
Lady Perusia	8	April 14	323	3346	16.83	6.76	563.2	226.2	263.9
Lavender	4	Farrow	365	5371	15.43	5.88	828.9	315.8	368.5
Lucerne	8	Nov. 8	283	5563	15.37	5.61	854.6	312.3	364.4
Max Belle	9	Aug. 23	330	4666	15.72	5.83	733.4	271.8	317.1
Max Ella	10	Jan. 11	308	7194	13.77	4.55	990.5	327.4	382.0
Mermaid	6	Feb. 11	295	6483	14.92	5.45	967.2	353.4	412.3
Minta Bella	10	Jun. 7, '02	314	5468	15.06	5.58	823.4	304.9	355.7
Mona	5	May 27	365	5746	14.51	5.11	833.4	293.7	342.7
Monterey	3	Jan. 22	311	5461	13.95	4.61	761.9	251.9	293.9
Nancy B	14	Apr. 24	288	5692	12.24	3.71	696.5	211.1	246.3
Naomi	6	Dec. 25	310	4400	14.01	4.41	616.1	194.0	226.4
Orpha	9	Apr. 7	297	5643	13.84	4.19	781.2	236.4	265.8
Pauline	6	Farrow	330	4257	15.30	5.35	651.1	227.7	265.7
Pomona	10	Dec. 28	323	5858	14.54	5.19	850.8	303.9	354.6
Powella	9	Mar. 31	351	5913	15.73	5.93	929.7	350.5	409.0
Pretoria	5	Sept. 29	351	3090	13.92	4.73	430.3	146.0	170.3
Primrose	9	Dec. 6	365	5200	13.77	4.51	715.8	234.4	273.5
Rosel	5	June 7	300	5925	14.68	4.96	869.5	293 9	342.9
Rosemary	7	Dec. 26	274	5509	13.87	4.55	764.2	250.7	292.5
Santa Clara	3	May 17'02	313	4227	15.52	5.72	656.0	241.8	282.1
Santa Rosa	3	July 17 '02	287	4926	14.10	4.63	694.6	227.9	265.9
Serena	5	Dec. 6	320	5488	13.97	4.57	766.0	250 6	292.4
Sonoma	3	*Jan3-Sep3	365	6117	14.86	5.16	908.7	315.7	368.3
Star Bright	5	*Sept. 21	316	5074	15.08	5.70	765.1	289.4	337.6
Stella	4	Jan. 6	249	5385	14.21	4.68	765.1	251.9	293.9
Sylvia	10	Jun. 9	299	4494	14.20	4.79	638.2	215.3	251.2
Vermont Una	2	Dec. 13	320	4578	14.82	5.39	678.4	246.9	288.1
Viola	5	Dec. 25	302	3892	14.40	5.06	560.3	196.9	229.7
Average			318	5166	14.53	5.03	750.6	263.6	307.5

*Aborted.

HERD RECORD. NOV. 1, 1901-OCT. 31, 1902

Cow	Total cost of food	Total cost of purchased grain	Cost of food for 100 pounds of milk	Cost of food for 1 pound of fat	Cost of food for 1 pound of butter	Proceeds from butter sales at 27¼ cents per pound	Value of fertilizing ingredients
	$	$	cts.	cts.	cts.	$	$
Acme 5th	47 90	18.45	66.3	18.3	15.7	84.86	29.52
Adelaide	56.91	27.22	108.6	20.8	17.9	88.40	32.35
Atalanta	44.80	19.75	92.2	24.2	20.8	59.92	27.78
Beautina of Hillcrest	50.58	18.46	86.6	18.0	15.4	91.07	30.80
Bertha	46.95	16.61	95.7	18.7	16.1	81.09	28.98
Buttercup	58.40	18.49	129.4	19.1	16.4	98.90	35.20
Ceres	52.53	21.00	75.5	14.7	12.6	116 07	32.20
Clare	56.80	26.70	80.5	16.7	14.3	110.03	32.48
Dahlia	42.86	16.61	107.9	19 4	16.6	71.57	26.03
Edith	54.40	24.85	97.7	18.2	15.6	96.73	34.35
Eunice	45.27	19.06	129.4	24.9	21.5	58.80	27.61
Eva	46.30	14.96	78.0	13 4	11.5	111.88	28.07
Fairie	49.33	21.03	107.6	20.7	17.7	77.20	30.49
Flora	44.86	18.49	90.2	18.4	15.7	79.09	27.67
Fresno	48.98	18 90	82.6	18.6	15.9	85.24	29.08
Goldenrod	52.32	19.83	116,7	18.1	15.5	93.64	30.40
Haidee	50 81	19.22	84.5	15.8	13.6	103.89	30.84
Hallowe'en	49.71	19.40	97.1	18.4	15.8	87 44	28,17
Idarella	47.42	18.23	146.1	30.4	26.0	50.53	29.08
Inez	48.55	18.45	94 3	17.3	14 8	90.91	29.98
Jersey Lily 2nd	39.39	18.70	131.4	19.2	16.4	66.52	23.80
Lady Perusia	54.55	28.31	163.0	24.1	20.7	73 23	32.15
Lavender	54.17	25.25	100.8	17'2	14.7	102.27	34.17
Lucerne	53.56	27.21	96.3	17.2	14.7	101.13	30.01
Max Belle	58.09	27.93	124.5	21.4	18 3	87.99	32.53
Max Ella	48.60	18.12	67.6	14.8	12.7	106.00	29.97
Mermaid	45.29	14.07	69.9	12.8	11.0	114.41	26.95
Minta Bella	50 98	23.58	93.2	16.7	14.3	98.70	27.69
Mona	59.18	25.07	103.0	20.1	17.3	95.10	37.80
Monterey	44.29	17.27	81.1	17.6	15.1	81.55	25.79
Nancy B	50.55	17.70	88.8	23.9	20 5	68.35	30.37
Naomi	47.79	17.64	108.6	24.6	21.1	62.82	28.09
Orpha	48.07	18.37	85.2	20.3	17.4	76.53	29.62
Pauline	47.43	20.78	111.4	20.8	17.9	73.73	28.19
Pomona	47.24	17.11	80.6	15.5	13.3	98.40	28.92
Powella	54.18	24.76	91.6	15.5	13.2	113.49	33.07
Pretoria	41.67	14.29	134.9	28.5	24.5	47.25	24.42
Primrose	52.21	21.07	100.4	22.3	19.1	75.89	28.84
Rosel	47.34	19.36	79.9	16.1	13.8	95.15	27.88
Rosemary	53.69	24.53	97.5	21.4	18.3	81.17	30.94
Santa Clara	44.89	15.29	106.2	18.5	15.9	78.28	27.10
Santa Rosa	40.61	13 73	82.4	17.8	15.3	73.79	23.67
Serena	50.07	19.96	91.2	20.0	17.1	81.14	29.14
Sonoma	50.39	20.59	82.4	16.0	13.7	102.30	31.46
Star Bright	49 32	18.73	97.2	17.0	14.6	93 70	30.62
Stella	47.09	18.13	87.5	18.7	16.0	81.55	27.34
Sylvia	50.74	20.34	112.9	23.6	20.2	69.71	31.60
Vermont Una	32.23	12.79	70.4	13.1	11.2	79.92	17.95
Viola	48.06	17.44	123.5	24.4	20.9	63.74	28.23
Average	49.13	19.78	98.5	19.2	16.5	85.33	29.37

HERD RECORD. NOV. 1, 1900-OCT. 31, 1901

Cow	Age November 1, 1901	Calved 1900-01	Served 1900-01	Days in milk	Milk	Total solids	Fat	Total solids	Fat	Butter
					lbs.	%	%	lbs.	lbs.	lbs.
Bertha	2	Dec. 12	.....	320	4673	15.14	5.33	707.5	249.0	290.6
Cowslip	5	Farrow	.....	141	1288	15.47	5.97	199.3	76.9	89.7
Dime	4	Jan. 20	.....	135	1170	12.27	3.51	143.6	41.1	48.0
Edna	7	June 22	Dead	186	2322	15.01	5.25	348.5	121.9	142.3
Jersey Lily	9	Dec. 27	Sold	81	1252	14.90	5.11	186.5	64.0	74.7
Jersey Lily 2nd	2	.....	May 27	153	1601	15.01	5.33	240.3	85.4	99.7
Monterey	2	.....	Jan. 22	283	4704	13.87	4.50	652.4	211.8	247.2
Nevada	2	.....	May 8	172	1837	14.77	5.26	271.4	96.7	112.8
Pussy Willow	9	Jan. 7	Jan. 7	263	3765	15.19	5.68	571.9	213.9	249.6
Salida	7	Feb. 6	Sold	62	469	15.56	5.80	73.0	27.2	31.7
Santa Clara	2	.....	Apr. 2	218	3588	14.67	5.17	526.2	188.4	216.4
Santa Rosa	2	.....	May 2	183	3428	13.65	4.36	467.9	149.3	174.2
Sonoma	2	.....	Sept. 7	55	1045	14.05	4.62	146.8	48.3	56.4
Suenette	5	July 21	Dead	227	2733	13.63	4.37	372.4	119.5	139.5
Sweet Brier	4	In fall	Sold	244	3030	13.59	4.51	411.8	136.6	159.4

Cow	Total cost of food	Total cost of purchased grain	Cost of food for 100 pounds of milk	Cost of food for 1 pound of fat	Cost of food for 1 pound of butter	Proceeds from butter sales at 27½ cents per pound	Value of fertilizing ingredients
	$	$	cts.	cts.	cts.	$	$
Bertha	42.04	17.45	90.0	16.9	14.4	79.92	24.79
Cowslip	20.55	9.05	159.6	26.7	22.9	24.67	14.58
Dime	22.54	10.81	192.6	54.6	46.0	13.20	15.98
Edna	33.39	17.29	143.8	27.4	23.5	39.13	22.40
Jersey Lily	12.03	2.53	96.1	18.8	16.1	20.54	8.02
Jersey Lily 2nd	15.36	6.06	95.9	18.0	15.4	27.43	6.27
Monterey	34.39	14.43	73.1	16.2	14.0	67.98	18.49
Nevada	16.06	6.40	87.4	16.6	14.2	31.02	6.66
Pussy Willow	36.50	12.77	97.0	17.1	14.6	68.62	22.15
Salida	10.82	4.57	230.7	40.0	34.1	8.72	6.79
Santa Clara	17.76	7.44	49.5	9.6	8.2	59.50	7.81
Santa Rosa	16.98	6.80	49.5	11.4	9.8	47.90	7.13
Sonoma	6.25	2.74	59.7	13.0	11.1	15.51	2.83
Suenette	47.87	23.54	175.1	40.2	34.4	38.36	33.89
Sweet Brier	39.74	16.91	131.2	29.0	25.0	43.84	26.14

Cow	Age November 1, 1901	Calved 1901-02	Served 1901-02	Days in milk	Milk	Total solids	Fat	Total solids	Fat	Butter
					lbs.	%	%	lbs.	lbs.	lbs.
Crystal Girl	2	Mar. 6	Sold	218	2756	13.34	4.07	367.7	112.1	130.8
Dorothy	2	Jan. 23	May 12, '02	279	3203	14.49	5.04	463.1	161.5	188.4
Elsa	5	Sept. 24'02	Nov. 30' 02	35	772	13.70	4.40	105.8	34.0	39.7
Janice	6	Aug. 31'02	Jan. 10, '03	60	995	14.16	4.44	140.9	44.2	51.6
Juanita	5	Aug. 1'02	Oct. 20, '02	78	1185	14.75	5.16	174.8	61.2	71.4
Katrina of Brondale	2	Sept. 28	Feb. 1, '03	32	332	14.25	4.80	47.2	15.9	18.6
Kimberley	2	Jan. 27, '02	May 1, '02	276	5033	12.83	3.81	645.5	191.7	223.7
Lilac	5	----------	----------	99	869	14.62	4.95	127.1	43.0	50.2
Lorna Doone	2	Feb. 24 '02	Farrow	247	3501	13.14	4.07	460.0	142.4	166.2
Maid Marian	10	Aug. 1, '02	Feb. 3, '03	78	1740	12.77	3.99	222.2	69.5	81.1
Nan	4	----------	----------	6	34	14.85	5.20	5.1	1.8	2.1
Nevada	3	----------	----------	120	834	15.71	5.97	131.1	49.8	58.1
Phyllis	3	Oct. 25	April 21, '02	290	4796	13.81	4.37	662.5	209.6	244.6
Red Top	12	Aug. 27	Farrow	271	4996	12.92	4.10	645.8	204.9	239.1
Sadie	4	Nov. 28	May 5, '02	259	3989	14.05	4.78	560.5	190.7	222.5
Surprise	2	Feb. 9	Sept. 2, '02	263	2778	14.94	5.26	415.1	146.2	170.6
Ursula	6	Aug. 1, '02	Dec. 2, '02	78	1576	14.27	4.94	224.9	77.9	90.9
Vivian	6	Jun 15, '02	Nov. 16, '02	78	1309	13.87	4.68	181.6	61.3	71.5
Yuba	3	Aug. 1	Jan. 14, '03	89	1593	14.14	4.79	225.3	76.3	89.0

Cow	Total cost of food	Total cost of purchased grain	Cost of food for 100 pounds of milk	Cost of food for 1 pound of fat	Cost of food for 1 pound of butter	Proceeds from butter sales at 27¾ cents per pound	Value of fertilising ingredients
	$	$	cts.	cts.	cts.	$	$
Crystal Girl	27.69	10.91	100.5	24.7	21.2	36.30	15.72
Dorothy	33.12	12.18	103.4	20.5	17.6	52.28	18.49
Elsa	7.00	1.82	90.7	20.6	17.6	11.02	3.23
Janice	6.89	1.91	69.2	15.6	13.4	14.32	3.15
Juanita	7.08	1.89	59.7	11.6	9.9	19.81	3.27
Katrina of Brondale	4.85	2.69	146.1	30.5	26.1	5.16	2.95
Kimberley	31.64	11.05	62.9	16.5	14.1	62.08	17.57
Lilac	19.97	5.95	229 8	46.4	39.8	13.93	13.44
Lorna Doone	25.95	10.73	74.1	18.2	15.6	46.12	13.08
Maid Marian	7.06	1.87	40.6	10.2	8.7	22.50	3.28
Nan	0.68	0.33	20.0	37.8	32.4	0.58	0.41
Nevada	13.66	6.49	163.8	27.4	23.5	16.12	9.44
Phyllis	44.56	21.22	92.9	21.3	18.2	67.88	29.57
Red Top	47.83	22.47	95.7	23.3	20.0	66.35	30.16
Sadie	38.40	16.47	97.5	20.4	17.5	61.74	26.10
Surprise	27.59	11.81	99.3	18.9	16.2	47.34	15.87
Ursula	7.82	1.89	49.6	10.0	8 6	25.22	3.82
Vivian	7.09	1.89	54.2	11.6	9.9	19.84	3.28
Yuba	11.75	4.23	73.8	15.4	13.2	24.70	6.00

*Nov. 1, 1902.

It is to be remarked, however, on the other hand, that many items other than those cited may be considered, in some degree at least, an offset against these expenditures and charges. Thus for example it should be noted:

1. That "roughages" are rated as figures sufficiently liberal to more than cover the cost of raising and harvesting in average seasons.

2. That the manurial constituents in the barn-fed-food are worth nearly half of its rated cost, if these are reckoned at the market prices for the same plant food of nearly if not quite the same availability furnished in the form of commercial fertilizers. There are also considerable amounts of plant food in the pasture grass eaten and thus transferred to the barn which are not included in this schedule.

3. That the manurial constituents in the purchased grain were worth, when similarly rated, about three-fifths of its market price.

4. That a ton of butter removes less than half a dollar's worth of plant food.

5. That the increase of the herd and the sales of calves and fat cows are further items not considered above.

6. That the skim-milk and buttermilk from 47 cows, at 20 cents per hundred (a low price as pork has ruled of late years, since these byproducts were found to be worth as much or more than this when dressed pork sold as low as five cents a pound), was worth for the two years over $900.00.

Herd records of this character have now been kept for eight years. A combined statement of these eight years' records is of interest and is shown in this article.

The herd, as a whole, made the most milk and butter to the cow during 1899-1900. The butter was made more cheaply during 1895-96. Yet, owing to better selling prices, the financial showing is best during the past few years. The excess of proceeds per cow over total cost of food for the eight years respectively, is $26.34, $32.51, $34.59, $34.18, $38.01, $44.72, $44.59 and $36.20. The more favorable results of the later years are largely due to better selling prices.

The following tables show extremes of quantity, quality, cost of production, etc., during each of the two years.

EXTREMES OF PRODUCTION

1900-1901

	Lowest amount for any cow		Highest amount for any cow	
Pounds of milk	1884	Sadie	10525	Rosel
Per cent of total solids	11.81	Acme 5th	16.18	Powella
Per cent of fat	3.57	"	6.34	"
Pounds of total solids	275.3	Sadie	1343.2	Rosel
Pounds of fat	100.0	"	456.6	Eva
Pounds of butter	116.7	"	532.8	"
Cost of feed	$34.32	"	$65.77	Nancy B
Cost of grain	$12.21	Polela	$30.94	"
Cost of 100 pounds of milk	57.2	Rosel	182.2	Sadie
Cost of 1 pound of fat	12.2	Ceres & Eva	34.2	"
Cost of 1 pound of butter	10.4	" "	29.4	"
Value of butter at actual selling price	$33.09	Sadie	$145.51	"
Value of fertilizing ingredients in food	20 66	"	$42.02	Nancy B

1901-1902

Pounds of milk	2998	Jersey Lily 2d	7225	Acme
Per cent of total solids	11.82	Acme 5th	16.94	Jersey Lily 2d
Per cent of fat	3.63	"	6.85	" "
Pounds of total solids	430.3	Pretoria	1010.4	Ceres
Pounds of fat	146.0	"	358.5	"
Pounds of butter	170.3	"	418.3	"
Cost of feed	$32.23	Vt. Una	$59.18	Mona
Cost of grain	$12.79	" "	$28.31	Lady Perusia
Cost of 100 pounds of milk	67.6	Max Ella	163.0	" "
Cost of 1 pound of fat	12.8	Mermaid	30.4	Idarella
Cost of 1 pound of butter	11.0	"	26.0	"
Value of butter at actual selling price	$47.25	Pretoria	$116.07	Ceres
Value of fertilizing ingredients in food	$17.95	Vt. Una	$ 37.80	Mona

The usual wide extremes are found. It cost nearly thrice as much to make a pound of butter from Sadie as it did from Ceres or Eva. It cost more for food alone to make the butter from Sadie's milk than it brought, even at the relatively high prices (25 and 30 cents) the station obtains for its product.

The writer was asked at a farmer's institute why the station kept Sadie if she was an unprofitable animal. He replied that it took some little while to discover her uselessness as a producer, and that, since she had been detected, she had been highly useful as a "horrible example."

Yet there are scores of towns in this dairy state that are full of Sadies. The cow census of the State Board of Agriculture taken several years ago disclosed this lamentable fact. It likewise showed that there were other Vermont towns with average butter productions of 225 to 250 pounds and more per cow. The cows were unlike in these two sets of towns. And—more important—so were the dairymen.

EIGHT YEAR HERD RECORD. 1895-1902

NAME	Years of record	Pounds of milk	Test	Pounds of butter	Total cost of food	Cost of purchased grain	Cost of food for 1 lb. of butter in cents	Proceeds from butter sales, 23.27¾ cts per pound	Pounds of butter each year							
									1895	1896	1897	1898	1899	1900	1901	1902
					$	$		$86.36								
Acme 5th	8	7634	3.80	339	49.92	18.28	14.9		383	386	340	294	302	335	362	306
Adah*	1	3422	5.11	204	33.46	16.53	19.4	52.99	----	----	----	----	204	----	----	----
Adelaide	2	5446	5.25	334	53.63	24.06	16.2	92.15	----	----	----	----	----	----	349	319
Annie*	1	2344	4.74	130	36.62	11.18	28.2	33.42	----	----	----	130	----	----	----	----
Atalanta	8	6862	3.79	303	49.13	19.31	16.7	77.92	298	315	314	272	429	239	346	216
Beautina	3	6480	5.03	381	55.72	22.72	14.7	104.72	----	----	----	----	----	440	375	328
Bertha	1	4904	5.11	292	46.95	16.61	16.1	81.09	----	----	----	----	----	----	----	292
Bessette*	1	5422	5.45	345	28.27	8.53	8.2	70.30	----	345	----	----	----	----	----	----
Bess*	4	6445	5.47	411	52.42	19.98	12.9	98.73	462	406	425	349	----	----	----	----
Betty*	5	5791	4.77	321	49.56	18.36	15.8	80.19	†281	†396	†245	347	321	----	----	----
Bonnie Belle*	1	4241	4.99	247	39.85	15.85	16.1	64.20	----	----	----	----	247	----	----	----
Brownie*	4	5811	5.31	360	47.32	19.52	13.6	86.28	331	459	357	293	----	----	----	----
Buttercup*	3	4914	6.28	357	54.20	18.74	15.2	98.35	----	----	----	----	----	329	387	356
Carmen*	1	4808	4.76	267	54.21	20.71	20.3	68.82	----	----	----	267	----	----	----	----
Ceres	5	6604	5.49	425	49.74	20.36	11.9	114.63	----	----	----	437	300	462	509	418
Clare*	5	5878	4.97	339	52.03	20.06	15.7	90.94	----	----	----	322	410	300	267	397
Clover*	5	4481	6.03	314	48.13	16.48	15.9	76.62	258	423	304	†263	323	----	----	----
Cowslip*	1	5834	5.59	381	52.19	23.95	13.7	103.70	----	----	----	----	----	381	----	----
Cressy*	2	4818	5.48	308	39.08	13.90	13.6	72.71	----	299	316	----	----	----	----	----
Dahlia	3	4681	5.67	310	48.16	19.76	15 9	85.16	----	----	----	----	----	407	265	258
Dandelion	5	5449	5.48	348	46.50	16.46	13.5	85.28	301	365	402	368	306	----	----	----
Dime	2	6908	3 83	264	42.41	15.82	16.1	70.26	----	----	----	----	258	270	----	----
Dora*	4	4783	5.63	314	44.87	17.96	14.3	75.79	369	†255	325	307	----	----	----	----
Edith	2	4741	5.36	297	48.66	21.20	16 6	81.89	----	----	----	----	----	----	244	349
Edna*	2	6 394	4.96	369	55.26	22 74	15.2	98.12	----	----	----	----	403	335	----	----
Effie*	1	5004	4.49	262	43.29	16.68	16.5	60.30	----	----	262	----	----	----	----	----
Eulalie*	6	6279	4.95	364	50.92	17.76	14.7	91.13	371	396	294	203	398	519	----	----
Eunice	2	4395	5.12	262	42.64	16.07	17.2	72.23	----	----	----	----	----	----	312	212
Eva	4	6122	6.45	458	51.37	20.28	11.3	123.95	----	----	----	----	466	427	533	403
Fairie*	8	5915	5.12	353	46.70	18.17	13.5	90.11	338	337	459	263	368	333	353	278
Fanny*	2	3448	5.17	208	44.61	16.81	11.7	48.45	245	171	----	----	----	----	----	----
Flora	8	6145	4.79	341	45.90	16.85	13.9	87.91	264	219	399	450	368	394	349	285
Flox*	3	5277	4.65	286	45.44	17.59	16.5	69.49	----	†346	†202	310	----	----	----	----
Fresno	1	5933	4.44	307	48.98	18 90	15.9	85.24	----	----	----	----	----	----	----	307
Goldenrod	8	5163	6.35	382	51.06	18.04	13.5	97.38	415	391	430	374	389	359	359	338
Goldie*	4	5366	5.50	344	50.68	18.59	15.0	83 18	356	275	396	349	----	----	----	----
Haidee	4	5821	5.67	384	50.74	20.51	13.3	104.25	----	----	----	----	326	451	384	374
Hallowe'en	2	5936	5.27	365	53.15	22.52	14.8	100.70	----	----	----	----	----	----	414	315
Hazel	1	2540	5.54	164	30 28	12 80	18 5	42.67	----	----	----	----	164	----	----	----
Helena*	1	2267	5 99	159	33.15	12.79	20.9	38.44	----	----	----	159	----	----	----	----
Idarella*	7	5437	5.11	326	49.06	18.49	16.3	83 77	----	356	401	378	355	397	215	182
Inez	4	5460	5.76	366	49.72	18.94	13.9	99.35	----	----	----	----	295	457	382	328
Jeannie*	4	5579	4.92	320	46.36	17.70	15 7	76.94	188	417	373	300	----	----	----	----
Jersey Lily*	6	5346	5 66	351	48.27	17 34	14.1	87.41	342	370	411	352	†251	380	----	----
Jersey Lily 2nd	1	2998	6.85	240	39.39	18.70	16.4	66.52	----	----	----	----	----	----	----	240
Jessaline*	2	4497	4.70	248	46.28	17.24	19.8	57.82	314	182	----	----	----	----	----	----
Jessie*	2	6063	5.78	408	48.64	16.35	12.0	94.93	458	358	----	----	----	----	----	----
Julia*	2	4962	5.79	334	43.25	16.38	13.0	77.65	347	321	----	----	----	----	----	----
Kinkora*	2	4264	5.45	269	43.04	15.16	16.1	62.52	292	246	----	----	----	----	----	----
Kittie*	2	4667	5.51	262	46.55	16.37	17.8	61.84	----	249	274	----	----	----	----	----
Lady LeBrocq*	2	4726	5.94	324	41.02	14.72	12.7	75.43	383	264	----	----	----	----	----	----
Lad Perusia	5	4504	6.16	322	48.37	19.45	15.8	86.53	----	----	----	210	413	377	347	264
Lala*	1	3950	5.20	240	40.02	13.99	16.7	61.74	----	----	----	240	----	----	----	----
Lavender	2	5799	5.74	388	54.70	24.66	14 2	106.96	----	----	----	----	----	----	406	369
Leah*	1	3840	5.65	253	40.98	17.28	16.2	65.81	----	----	----	----	253	----	----	----
Lilac*	3	4499	4.71	247	42.43	16.25	17.1	66.63	----	----	----	----	205	268	267	----
Lucerne	2	5575	5.77	375	51.39	23.38	13.7	103.64	----	----	----	----	----	----	386	364
Maizie*	5	5454	4.70	297	45.56	17.34	16 6	72.80	355	194	415	†169	353	----	----	----
Marjory*	3	5888	5.26	361	46.61	17.00	13.2	88 29	----	335	293	454	----	--	----	----
Max Belle	7	4136	6.11	293	46.73	18.86	16.0	76.52	----	†262	262	230	319	334	330	317

* Not now in the herd. † Aborted.

EIGHT YEAR HERD RECORD. 1895-1902

NAME	Years of record	Pounds of milk	Test	Pounds of butter	Total cost of food	Cost of purchased grain	Cost of food for 1 lb. of butter in cents	Proceeds from butter sales, 33-27¼ cts. per pound	Pounds of butter each year							
									1895	1896	1897	1898	1899	1900	1901	1902
Max Ella	5	7105	4.73	392	49.71	18.13	12.8	105.41	----	----	----	309	414	428	427	382
Mermaid	2	6544	5.87	449	48.76	17.22	10.9	123.82	----	----	----	----	----	----	485	412
Minta Bella	7	5712	6.00	398	46.25	17.49	11.6	103.19	----	†345	450	390	381	458	404	356
Mona	3	6296	5.08	373	55.07	20.99	14.9	102.49	----	----	----	----	----	393	383	343
Monterey	1	5461	4.61	294	44.29	17.27	15.1	81.55	----	----	----	----	----	----	----	294
Nan*	1	4373	5.19	265	43.41	15.07	16.4	72.82	----	----	----	----	----	----	265	----
Nancy B.	8	7664	3.88	347	53.84	19.86	15.8	88.79	356	288	416	340	390	340	400	246
Naomi	5	5629	4.61	303	47.27	16.98	15.9	82.24	----	----	----	287	306	359	340	226
*Nett**	2	7680	4.02	360	50.06	16.63	14.0	83.85	393	327	----	----	----	----	----	----
Orpha	4	5697	4.46	298	48.93	21.23	17.4	80.86	----	----	----	----	326	186	405	276
Pauline*	5	5647	4.93	323	47.25	17.92	14.7	86.73	----	----	----	309	321	365	354	266
Phyllis*	1	4782	4.41	246	39.27	15.06	16.0	67.92	----	----	----	----	----	----	246	----
Polela*	4	4525	5.41	287	43.52	13.62	15.2	76.01	----	----	----	323	317	252	252	----
Polly*	2	5830	5.49	374	48.35	15.41	13.0	106.65	----	----	----	412	336	----	----	----
Pomona	5	6229	5.45	397	48.93	17.71	12.4	106.37	----	----	----	446	369	418	396	355
Portellette*	2	6674	4.46	363	48.28	16.26	13.6	84.19	342	383	----	----	----	----	----	----
Powella	2	5566	6.14	398	52.09	24.03	13.1	109.79	----	----	----	----	----	----	386	409
Pretor a	3	4807	4.89	276	48.60	20.65	19.0	75.65	----	----	----	----	----	390	267	170
Primrose	2	5230	4.64	284	53.14	22.26	18.8	78.17	----	----	----	----	----	----	293	274
Priscilla*	3	4464	5.84	304	48.03	17.59	15.8	80.36	----	----	----	272	291	350	----	----
Pussy Willow*	3	4875	5.69	324	46.35	14.77	14.3	85.37	----	----	----	324	302	345	----	----
Rachel*	3	5516	5.86	377	45.13	17.47	12.0	49.33	----	----	----	333	367	430	----	----
Red Top*	7	6530	4.28	326	51.39	17.28	16.3	82.07	284	358	460	294	315	321	247	----
Regina*	3	5693	4.05	270	47.22	18.18	17.9	63.37	268	311	230	----	----	----	----	----
Rhoda*	1	5015	4.87	285	48.40	18.21	17.0	66.93	285	----	----	----	----	----	----	----
Rose*	2	3464	5.61	226	36.54	12.41	16.3	58.51	----	----	----	204	248	----	----	----
Rosel	2	8225	4.61	433	53.78	23 05	12.7	119.41	----	----	----	----	----	----	522	343
Rosemary	3	5138	4.79	286	48.22	20.62	16.8	78.65	----	----	----	----	----	273	293	293
Rowena*	6	6175	4 58	339	49.63	17.52	15.6	82.38	211	384	360	351	340	331	----	----
Ruth*	3	4468	4.80	249	48.68	18.96	19.5	65.78	----	----	----	240	238	270	----	----
Sadie*	1	1884	5.31	117	34.32	12.47	29.4	32.09	----	----	----	----	----	----	117	----
Salida*	4	3815	5.18	230	44.54	16.33	22.4	60.10	----	----	99	275	273	273	----	----
Santa Clara	1	4227	5.72	282	44.89	15.29	15.9	78.28	----	----	----	----	----	----	----	282
Santa Rosa	1	4926	4.63	266	40.61	13.73	15.3	73.79	----	----	----	----	----	----	----	266
Serena	3	5279	4.85	298	48.81	19.52	16.3	82.07	----	----	----	----	----	323	280	292
Sonoma	1	6117	5.16	368	50.39	20.59	13.7	102.30	----	----	----	----	----	----	----	368
Star Bright	4	5079	5.63	334	46.58	18.69	13.9	90.75	----	----	----	----	258	349	390	338
Stella	2	5331	4.80	299	48.93	19.93	16.4	82.41	----	----	----	----	----	----	303	294
*Suenette**	2	6952	4.37	354	56.85	22.83	16.1	94.34	----	----	----	----	324	384	----	----
Sylvia*	4	5179	4.93	298	52.23	19.82	17.8	80.69	----	----	----	----	256	361	321	251
Vermont Una	1	4578	5.39	288	32.23	12.79	11.2	79.92	----	----	----	----	----	----	----	288
Viola	4	3968	5.24	243	43.49	15.66	18.0	65.83	----	----	----	----	239	254	247	230
Waxy*	1	4892	4.74	270	43.19	17.39	15.9	63.94	270	----	----	----	----	----	----	----
Aver. record 1895	33	5633	4.95	325	50.06	18.85	16.2	76.40								
" " 1896	37	5431	5.12	324	42.00	14.22	13.8	74.51								
" " 1897	29	5730	5.06	338	47.45	18.69	15.3	82.04								
" " 1898	42	5296	5.06	313	46.40	15.73	15.6	80.58								
" " 1899	47	5462	5.02	320	45.17	15.57	14.5	83.18								
" " 1900	45	5935	5.15	357	52.43	21.20	15.2	97.15								
" " 1901	47	5814	5.07	344	49 97	20.25	15.2	94.56								
" " 1902	49	5166	5.03	308	49.13	19.78	16.5	85.33								

* Not now in the herd. † Aborted.

The foregoing table shows the feeding record of each cow which was a member of the herd either year. All of them were out to pasture each year during the daytime for about five and one-half months, but were housed over night. They were fed twice daily the year around, grained somewhat during the latter part of each summer, watered in winter twice a day, and turned out in the winter for from 20 to 40 minutes daily except in extreme weather. The station herd is used in feeding experiments from November to June, during which time many of the cows are subjected to changes in ration. In some cases materials may be fed which are distasteful, and, frequently, wasteful or ill-balanced rations are designedly used. These changes, necessitated by the conduct of feeding experiments, are obviously not conducive to maximum production. At no time was special effort made to select or to feed the most economical ration, or to force any cow to her utmost.

With the exception of the registered animals, and some of the younger animals which were raised by the station, these cows are "farmers' cows," bought by a Vermont farmer at moderate prices, from farmers' herds within the limits of two contiguous Vermont towns. It is clear that such cows yielding from 300 to 350 pounds are better worth $50.00, the approximate average price paid, than is the average Vermont cow, which gives not much more than 150 pounds of butter a year, worth half that sum. It is quite practicable for a thoroughly good judge of cows to get together another such herd by the expenditure of some time and trouble and by the investment of a moderate amount of money. It is hoped that the study of this record by Vermont farmers will lead many to breed better cows, to feed good cows better, and to cull out unprofitable animals.

NAME	Hay	Partly dried grass	Silage	Apple pomace or apples	Pumpkins	Corn meal	Wheat bran	½ cottonseed meal ½ linseed meal	Chicago gluten meal	Germ oil meal	Ground oats	Atlantic gluten flour
Acme	2639	854	5406			237	1521	492		13	23	
Adelaide	2720	931	5674			213	1436			2	515	113
Atalanta	2381	940	6634			261	1834	44	618	12		
Beautina	2873	963	7084			265	1576	514		16	2	
Bertha	1838	905	5424			207	1135	305		13	46	
Buttercup	3400	1104	6070			274	1275	48		13	315	
Ceres	2437	894	5824			202	1635	46	536	13	27	
Clare	2440	542	4121	771		128	1356	555		13		
Cowslip	1640		1276		1389	9	561	274				
Cream of Jersey	2973		4056		1395	30	1133	539		11		35
Dahlia	2425	839	5413	404	609	211	1201	390		10		65
Dime	1601		2177	364		12	667	328				
Edith	2961	668	2591			121	1105	430		13		
Edna	2205		3232			20	1055	301		136	153	
Eunice	2443	726	4549	365	1079	166	810	44		181	110	
Eva	2379	982	7931			266	1529	52		330	283	
Fairie	2277	945	5616			283	1335	354		9		
Flora	2865	948	5504			279	1156	52	183	16	62	
Goldenrod	3762	1073	5075			275	1319	349		16	33	
Haidee	3009	968	5854			265	1283	344		14	26	
Hallowe'en	3196	964	5027			249	1638	566		13		
Idarella	3183	901	5493			251	1292	42		13		
Inez	2801	915	5672			210	1306	441		14	1	
Jersey Lily	1517		1279			8	172				82	
Jersey Lily 2nd	82	607	1584			170	410	29		9		
Lady Perusia	3196	981	5014			254	1230	267		13	93	
Lavender	2635	962	7041			232	1573	46	517	13		
Lilac	2797	965	5153	365		253	1307	337	64	13		
Lucerne	2650	609	6599			117	1322	45		13	508	135
Max Belle	2343	819	4903			186	1376	46		151	377	
Max Ella	2548	955	7030			238	1380	46		13	397	37
Mermaid	2734	980	7162			260	1336	46	370	13		
Minta Bella	3184	960	5372			273	1132	275		15	44	
Mona	3731	1106	6339			281	1098	274		12		
Monterey	1385	878	3886			197	850	44		324	17	
Nan	2466	757	6078			193	991	45	256	14		
Nancy B	3710	1047	5772			239	1955	739		14	6	
Naomi	2743	954	5958			219	1182	45		14	316	
Nevada	82	661	1732			188	430	28		8		
Orpha	2437	940	6735			254	1630	45	517	14		
Pauline	2915	982	5266	330		253	1276	265		14	119	
Phyllis	2335	161	4118	757		54	938	412		14		
Polela	2690		4798				752	375		8		
Pomona	2955	946	5539			252	1279	43	210	14	134	
Powella	2439	985	4704			274	1588	54		15	463	
Pretoria	2392	823	5005	771		205	1441	517		12		30
Primrose	3457	1003	3893			184	1487	556		13		
Pussy Willow												
Red Top	3185	944	4519			184	1335	6		5	497	75
Rosel	3059	964	7191			293	1610	327		374		
Rosemary	2534	603	5782			121	1060	260		219	33	
Sadie	2226		3192	752		11	764	383		2		44
Salida	951		1003			16	309				147	
Santa Clara	10	928	1965			197	503	44		14		
Santa Rosa	10	889	1942			219	471	9		7		
Serena	2843	525	5039			120	995	43		233	223	
Sonoma		567	396			95	190					
Star Bright	2786	1012	7157			237	1235	196		334	15	
Stella	2557	928	5952			215	1474	44		14	486	109
Suenette	3722		3816			25	1523	5	741	3		
Sweet Brier	2911		5014			34	940	229		398	9	
Sylvia	3772	1006	5466			264	1449	472		8		
Viola	2864	941	6184			205	1007	43		299	150	

NAME	Hay	Silage	Green oats	Green rowen	Hungarian and alfalfa	Wheat bran	½ cottonseed meal ½ linseed meal	Corn meal	Germ oil meal	Dried brewer's grains	Malt sprouts	Ground oats
Acme	3251	3919	693	653	207	1051	279	233	28	14	17	25
Adelaide	2874	5384	669	646	181	1025		228	987	13	9	22
Atalanta	2610	3353	510	613	202	1195	369	226				
Beautina	3803	3678	784	711	233	1062	29	230	27	14	17	24
Bertha	3556	3467	696	633	235	937	245	210	29	14	17	26
Buttercup	4756	5519	784	791	261	772	29	235	479	14	17	26
Ceres	3601	4088	699	642	237	840	71	139	29	811	17	26
Clare	2931	5406	675	645	216	998	29	235	918	14	17	25
Crystal Girl	1282	2029	676	629	237	588	181	102	29	14	17	26
Dahlia	2781	3328	687	634	236	934	254	206	28	14	17	25
Dorothy	1879	2856	626	617	235	582	33	105	21	10	178	124
Edith	2884	5257	621	621	238	1427	476	228	29	14	17	26
Elsa	633					113		56				
Eunice	2415	5509	519	51		921	249	106	29	377	17	26
Eva	3562	4116	696	633	238	613	32	139	30	515	17	27
Fairie	2774	5290	463	298	227	850	31	209	29	60	737	27
Flora	2585	4247	529	598	236	1036	231	225			208	
Fresno	2965	5273	686	640	234	775	29	182	30	673	21	27
Goldenrod	3552	5113	532	597	236	789		226	669			
Haidee	3716	3855	607	631	236	1105	29	230	30	15	16	27
Hallowe'en	3457	3824	671	605	253	1034	66	233	30	15	16	244
Idarella	3309	3599	635	643	208	1032	270	234	30	15	16	27
Inez	3523	3452	682	631	233	719	83	87	30	740	16	27
Janice	601				11	115		58				
Jersey Lily 2nd	1952	2728	549	562	108	1077	354	177	21	11	13	20
Juanita	631				17	117		58				
Katrina	432					176		76				
Kimberley	1864	2882	686	378	233	432	33	102	245	15	85	27
Lady Perusia	2322	5009	609	572	233	938	26	158	298	1104	13	26
Lavender	2959	4565	661	501	246	1454	479	233	30	15	16	27
Lilac	1942	2229		644		266		94	155			
Lorna Doone	1266	1795	549	34	212	429	21	112	297	11	13	20
Lucerne	2663	5223	102	34		863	27	105	1178	14	15	25
Maid Marian	634				17	116		57				
Max Belle	2038	5398	696	637	238	946	29	172	1101	15	16	27
Max Ella	3486	3808	691	624	227	1034	66	138	30	15	16	30
Mermaid	3695	3687	611	606	245	659	29	231	30	285	16	27
Minta Bella	2853	3970	585	626	235	960	34	233	28	47	227	393
Mona	3768	5262	690	660	216	1442	476	233	30	15	16	27
Monterey	2884	3508	691	635	236	802	98	219	314	15	16	27
Nan	47	75				20		10				
Nancy B	4102	3337	694	653	206	980	175	233	30	15	16	98
Naomi	3378	3951	679	631	235	862	29	137	30	15	255	203
Nevada	917	1722				390	126	71				
Orpha	3365	3698	668	635	236	1044	276	232	30	15	16	27
Pauline	2335	5326	693	585	48	805	23	160	20	902	13	17
Phyllis	2365	5355	583	50		1202	474	119	29	15	16	27
Pomona	3359	4121	594	584	265	641	41	85	29	747	16	27
Powella	2914	5063	654	604	246	1198	194	233	29	578	16	23
Pretoria	2946	5097				599	1	148	3	595	1	9
Primrose	3327	4667	661	591	242	1135	22	197	22	11	15	357
Red Top	2849	5431	247	35		812	29	96	30	1092	16	25
Rosel	2844	4047	773	778	259	934	28	233	29	15	349	137
Rosemary	2943	5042	654	382	235	801	33	82	1040	15	16	
Sadie	2324	4937	546	51		805	260	31	29	15	324	28
Santa Clara	3359	3696	632	689	180	716	10	207	28	394	9	28
Santa Rosa	2698	4222	546	654	179	673	8	232		370	5	
Serena	3047	5092	629	637	232	748	33	135	696	15	16	27
Sonoma	2921	5323	629	697	151	1168	368	209	30	15	16	27
Star Bright	3460	3975	686	632	236	1068	98	128	30	15	21	27
Stella	3316	3871	671	382		586	28	74	740	15	16	26
Surprise	1187	2069	505	614	46	669	223	102	18	9	12	16
Sylvia	3345	4023	742	741	252	1161	335	236	28	13	15	26
Una	1739	2916	548	292	47	515	25	76	22	454	13	57
Ursula	779				18	117		58				
Viola	3398	4225	680	692	151	619	34	103	632	15	16	27
Vivian	638				7	117		58				
Yuba	638		417	644	151	261		130				

All the cows other than those named hereafter ate also from 3 to 5 pounds of King gluten meal. Atalanta, Elsa, Flora, Goldenrod, Janice, Jersey Lily 2nd, Juanita, Katrina of Brondale, Lilac, Maid Marian. Nan, Nevada, Pretoria, Santa Clara, Santa Rosa, Ursula, Vivian and Yuba had none. Beautina ate 268 pounds, Haidee, 287 pounds, Max Ella, 306 pounds, Star Bright, 302 pounds of King gluten meal.

A COMPARISON OF SCORE CARD JUDGMENTS AND OF MILK AND BUTTER RECORDS

There seems to be much diversity of opinion among experts as to the merits of an individual animal. Different men possess different ideals. One lays stress on symmetry of form, another on what he deems fitness for functional performance, a third may be guided largely by intuition, while others judge mainly by certain single points as, for instance, in the cow, the texture of the skin, or the size and torturosity of the "milk vein," or the so-called "pelvic arch," or the loosely connected vertebra or the escutcheon. The sundry associations of breeders of domestic animals as well as some instructors in animal husbandry have prepared "score cards" for use in judging cattle, which have had more or less vogue and which serve to some degree to make stock judging more exact; yet, as a matter of fact, they are not as largely used as they should be, and, even when resorted to, are likely to afford varying results in different hands. These cards moreover are highly variant and often reflect individual ideas rather than concerted action. Thus the whole system of show ring awards is really based mainly on personal judgment guided sometimes by a scale of points wherein supposed excellences are given what are held to be proportionate values.

An old adage affirms that "handsome is that handsome does." Domestic animals are kept for profit, and satisfactory performance ought to be the true measure of worth. In these days of herd records and Babcock tests it seems as if, so far as dairy cows are concerned. deeds rather than looks should form the basis of prize allotment, or, at least, be recognized in the score card. It would seem as if 300 pounds of butter a year were better entitled to influence a decision than the contour of a cow's legs, and a large milk flow than the crumpling or coloring of the horns. Yet if it should appear that show ring judgment, faulty and highly variant though it may be, in any degree parallels performance, the desirability of according a place on the score cards to milk and butter yields is less evident. It was with a view of adding to our information on this point that the writer suggested to Mr. R. R. Strait of the class of 1902 the comparison of

scoring and of production records as a subject for graduation thesis from the agricultural department of this University. The present article is based on the results of Mr. Strait's work.

In the course of this study access was had not only to the Station herd of registered and high grade Jerseys and registered Ayrshires, but, also, to the registered Ayshire herds of Mr. L. S. Drew of South Burlington,ex-president,and of Hon. C. M. Winslow of Brandon, secretary of the Ayrshire Breeders' Association. Full records have been made for the two Ayrshire herds for several years, and for three years these have been frequently checked and supervised by the Experiment station; so that it is not too much to say that the records of all three herds have been essentially kept by station officers. Mr. Strait, in preparation for his work, received special instruction in stock judging from the University instructor in that subject, and was also assisted by Messrs. Drew and Winslow, who are veteran show ring judges. The cows were generally judged twice and independently. It is felt that the results were arrived at with rather more care than is generally used. It should be remarked, moreover, that Mr. Strait was in entire ignorance of the records made by the cows when he was scoring the Drew and Winslow herds. The records of the animals belonging to the station are posted above the stanchions.

The scoring being completed a comparison of scores and of average yields of milk and butter for periods of from one to eight years was then made ,using 83 cows in the three herds. It was found necessary to throw out of consideration the records of the two and three year old heifers, as they had not arrived at full production, although sometimes approximating perfection in scoring. Their inclusion, therefore, greatly obscured the matter. Hence the records of but 62 cows were used. Inasmuch as the results arrived at in individual cases mean but little, and since errors of judgment are minimized when numbers are massed together, the results of the comparison are submitted in groups, those scoring highest ranking first. The highest individual score was 97 and the lowest 80.

Group	Herd owned by	Hon. C. M. Winslow			Mr. L. S. Drew			Vt. Exp. Station		
	Scores	Number of cows	Milk	Butter	Number of cows	Milk	Butter	Number of cows	Milk	Butter
			lbs.	lbs.		lbs.	lbs.		lbs.	lbs.
1	92 and above	5	6710	309.4	4	6562	323.5	7	6823	360.7
2	90-91	--	----	----	9	5743	262.3	5	6116	358.0
3	88-89	6	7121	318.6	5	5629	282.8	9	6039	372.3
4	87 and below	4	5908	251.9	5	5881	275.4	3	5308	331.0

Uniting all these records into one table giving each herd equal value in each group regardless of the variation in the size of the groups, the following showing is made. It may be well to state that if to each group is given its numerical value the differences become greater; hence the table affords a conservative statement of the general outcome.

Groups 1 and 2	.....30 cows	6478 lbs. milk	320.6 lbs. butter
Group 3	.....20 cows	6263 lbs. milk	324.6 lbs. butter
Group 4	.....12 cows	5699 lbs. milk	286.1 lbs. butter

So far as this comparison goes it seems to show that cows scoring high—and consequently likely to take show ring prizes—are really in the long run little if any better producers than are their less well equipped sisters. But, on the other hand, it shows plainly a relationship between lack of conformation to dairy types and lessened production.

One-fifth of the total number of mature cows scored relatively low, (87 or below) and in each herd these cows as a class ranked lowest in butter production, and, in two of the three, lowest in milk production. The average milk and butter yields as compared with those of their mates scoring better were lessened an eighth. Ten of the twelve cows comprised in class 4 individually made less than the average amount of butter given by the cows of class 3. In other words, the relatively "poor lookers" were poor yielders, and, in relegating them to the rear, the show ring judgment does not err. But it may and, doubtless, does often work injustice in awarding prizes to cows which are really inferior as producers to others which do not look quite as well, and consequently do not score as high. Several of the breeders' associations recognize the importance of attested milk and butter records by "advanced registry" or otherwise. Is it not time, however, that merit as measured by performance should be accorded a place on the score card?

THE EFFECT OF FEED ON THE QUALITY OF BUTTER

In continuation of the work of the past five years cited in the several reports, further time has been spent in studying the effect of sundry feeds on the character of the butter. One hundred and ninety-one separate churnings were made and as many samples of butter milk and butter taken and critically examined as to their quality. Each churning represented four milkings. The butter was composited into forty-three samples for analysis. These trials were made in connection with the feeding experiments discussed in previous pages of this report, beginning in mid-February and lasting for more than three months. The milk of several groups of cows were seperately handled and data is at hand showing something of the effects, if any, of the following fodders and feeds on butter quality. Apple pomace silage, corn silage, No. 1 feed (bran, cottonseed and linseed meals), malt sprouts, dried brewers' grains, ground oats, germ oil meal, King gluten meal.

EFFECT ON BUTTER

The following statement shows the results of analyses of the butter made on the sundry rations, maxima, minima and averages being given. There was considerable shifting about of individuals during the three months feeding so that it is felt that the effects of bovine idiosyncracy and of varying stages of lactation are minimized and that such abnormalities as are observed are feed characteristics.

Character of feed	Number of samples analyzed	Number of churnings represented	Volatile acids (c. c. N-10 alkali)			Iodin number			Melting point in °C		
			Minimum	Maximum	Average	Minimum	Maximum	Average	Minimum	Maximum	Average
Apple pomace	8	36	28.9	29.9	29.3	28.6	31.5	29.8	32.6	33.8	33.1
Corn silage	3	12	28.9	30.4	29.7	29.7	30.8	30.2	32.6	33.	32.8
No. I feed	5	24	28.3	30.1	29.3	29.4	30.	29.8	32.1	33.5	32.7
Malt sprouts	11	49	27.6	29.6	28.7	25.7	29.4	27.8	32.	33.5	32.8
Ground oats	5	24	27.7	29.5	28.9	26.6	27.6	27.1	32.5	33.4	33.
Dried brewers' grains	6	25	28.3	29.2	28.8	28.2	29.4	28.7	32.7	33.2	32.9
Germ oil meal	2	8	28.6	28.9	28.8	31.4	32.3	31.9	32.9	33.3	33.1
King gluten meal	3	12	30.3	30.6	30.4	26.5	28.2	27.4	31.6	32.3	31.9

Apple pomace, corn silage, the No. 1 feed and dried brewers' grains show no measurable effect on the quality of the butter as measured by analysis.

Malt sprouts.—A somewhat low iodin number was noted in the butter from cows thus fed and a tendency to lessen it as feeding progressed.

Ground oats.—Lowest of all the iodin numbers. The individual samples showed consistently low results.

Germ oil meal.—A high iodin number was found in the two samples representing this feed. The result is quite in accord with last year's results.

King gluten meal.—The results here are emphatic. The minimum volatile acid content exceeded 39 out of 40 results with other butters; the maximum melting point was lower than 38 out of 40 results; and the iodin numbers ranged low. The gluten products tend to soften butter. The first two of these observations is in line with that notion but the third is not.

EFFECT ON CHURNING

Full data of every churning was taken throughout the three months and every buttermilk was analyzed. Some of the churnings were so small that the losses in the buttermilk as well as extra long churnings may be in part charged thereto. Yet there were but few which were abnormal in this respect. The buttermilks from the cream of the pomace-fed cows averaged somewhat richer than was the case with the other rations, but the difference was not great enough to lay much stress upon it. The cream from the cows fed malt sprouts, a feed which was reluctantly eaten, churned out better than did any other cream.

EFFECT ON THE QUALITY OF BUTTER AS MEASURED BY INSPECTION

The butter made during May from the milk of two cows, well along in lactation, fed malt sprouts and eating it reluctantly, was inferior and unsalable. This condition was not met with the butter made on this feed from December to April. Barring this one difficulty the station buttermaker could observe no ill effect on the character of the butter made on these sundry rations which could be attributed to the feed; nor, indeed, did any of the large number of private customers to whom the product was sold raise any objections. On the contrary it was said that the station had never sold better winter butter. It would seem, therefore, that none of these feeds were a detriment to the quality of the product.

THE CHANGE FROM BARN TO PASTURE

The food, environment and mode of life of the pastured cow are utterly unlike those she encounters in the stable. So profound a change may well be expected to affect her milk flow. That she makes more milk when out of doors than when housed is well understood; but whether that milk is richer or poorer in fat is less certain.

Some study was given to the question of the effect of this annual out-going upon the milk flow during the earlier years of the station and notes thereon were published at various times.[1] Much more data has been accumulated during the past decade and it seems worth while to bring the matter up to date.

[1] Vt. Sta. Rpts., 3, pp. 80-82 (1889); 4, pp. 101-110 (1890); 5, p. 69 (1891); 6, pp. 155-156 (1892); 7, pp. 107-109 (1893).

The station herd during the past nine years has consisted of from 30 to 60 cows. It has been under constant observation as to its food and product. Each year as it has passed out to grass careful note has been taken of the quantity and the quality of the milk given by each individual. The figures shown herewith are based upon these observations and cover eight years, 1895-1902.

The herd is composed of cows coming in at all times in the year. Stripper cows were excluded from the records used in making the present comparisons.

When the data were collated it was seen at once that three quite distinct sets of results were obtained.

1. An immediate and decided improvement in quality, followed, in from two to four weeks, by a return to the pre-pasture quality.

2. A slower change with a tendency towards improvement.

3. No change in quality.

The following tables show the salient results of this inquiry grouped in the three sets just indicated.

QUANTITY AND QUALITY OF MILK YIELD.

(1) In the barn for two weeks prior to pasture; (2) on pasture for first two weeks; (3) on pasture for next four weeks.

Year	Number of cows	Milk yield			Percent of total solids			Percent of fat		
		(1)	(2)	(3)	(1)	(2)	(3)	(1)	(2)	(3)
1896	32	100	114	112	14.48	14.88	14.60	5.19	5.58	5.36
1900	42	100	108	101	14.56	14.80	14.37	5.07	5.42	5.20
1901	42	100	102	94	14.01	14.48	14.01	4.95	5.39	4.96
1902	49	100	102	99	14.03	14.71	14.13	4.84	5.17	4.80
Av'ge	*41*	*100*	*106 1-2*	*101 1-2*	*14.27*	*14.71*	*14.28*	*5.01*	*5.39*	*5.08*
1899	45	100	99	92	13.90	13.90	14.17	4.88	5.02	5.18
1895	30	100	109	96	14.38	14.40	14.15	5.12	5.09	5.11
1897	26	100	112	108	14.56	14.56	14.54	5.14	5.13	5.14
1898	39	100	103	106	14.30	14.13	14.13	5.06	5.11	5.00
Av'ge	*32*	*100*	*108*	*103 1-2*	*14.41*	*14.36*	*14.27*	*5.11*	*5.11*	*5.08*

NOTE.—The quantity of milk during the last two weeks of barn life was considered standard (100) and the yields in the other periods compared therewith on the hundred basis.

SHOWING PERCENT OF TOTAL NUMBER OF COWS GIVING

(1) Better milk, (2) milk of unchanged quality, (3) poorer milk —on pasture as compared with barn feeding.

Year	Number of cows	Within two weeks			Within next four weeks			Week of going to pasture
		(1)	(2)	(3)	(1)	(2)	(3)	
1896	32	87	10	3	62	31	7	Second in May
1900	42	81	19	0	36	59	5	Fourth " "
1901	42	90	7	3	31	57	12	" " "
1902	49	80	18	2	41	49	10	" " "
Av'ge	41	85	13	2	42	49	9	
1899	45	31	62	7	67	29	4	Fourth in May
1895	30	17	57	26	26	37	37	Second in May
1897	26	15	81	4	23	65	12	
1893	39	23	59	18	15	49	36	Third " "
Av'ge	32	18	66	15	21	50	28	

1. *Immediate and decided improvement followed by return to original quality.* During four of the eight years in the first two weeks of pasture life five-sixths of the cows bettered[1] the quality of their flow, one-eighth did not alter it, while only 2 percent gave poorer[1] milk. During the next four weeks—as compared with the record on barn feeding—four-sevenths of the cows bettered the flow, one-half gave milk of unchanged grade and a scant one-tenth made milk of a lowered quality. Six and one-half percent more milk was made during the first two weeks and one and one-half percent more during the next four than during equivalent times during barn life. Average fat and solids-not-fat figures were for barn, initial and later pasture periods, 5.01, 5.39 and 5.08 percents fat, 9.26, 9.32, 9.20 percents solids-not-fat. The butter yields of the three periods were 100, 115 and 103, the barn period representing 100.

2. *Slow tendency towards improvement.*—In 1899, a very drougthy spring, a third of the herd improved the milk flow, during the first two weeks on pasture, rather more than three-fifths did not alter its character, while 7 percent of the cows gave thinner milk. During the next four weeks, however, more than a third of the herd, which prior to that time had not shown the effect of pasture by an increase-

[1] I. e. changed it 0.20 percent or more. A smaller alteration than this was disregarded and considered "no change."

ment of the fat percentage, gave a better quality of milk. This made the one-third of the first pasture period two-thirds and the three-fifths, less than one-third. In other words, the bettered quality resulting from the change to pasture observed in the four years' trials just discussed was also ootained during the dry spring of 1899, but its arrival was delayed and its extent lessened probably because of lack of rain. One percent less milk was given during the first two weeks of pasture feeding than was yielded in the barn, and eight percent less in the later pasture periods. Again a clear case of cause (dried pastures) and effect (shrunken yield). Average fat and solids-not-fat percentages were for barn, early and late pasture periods, 4.88, 5.02, 5.18 percents fat, 9.02, 8.88, 8.99 percents solids-not-fat. The butter yields of the three periods, the barn feeding representing unity (100), were 100, 102 and 98.

3. *Unchanged quality.*—During three years, 1895, 1897 and 1898, a sixth of the herd bettered, a sixth lowered and two-thirds of the cows maintained an even quality of the milk when first passing out on pasture. After two weeks had fled, however, a fifth improved, more than a quarter lessened and a half gave an unchanged grade of milk for the ensuing month. Eight percent more milk was made at the outset, following the change and three and one-half percent more during the next month than was made in the barn. Average fat and solids-not-fat were as follows for barn, early and late pasture life: 5.11, 5.11, and 5.08 percents fat, 9.30, 9.25 and 9.19 percents solids-not-fat. The butter yields of the three periods, expressed percentagely, closely parallel the milk yield because of the uniformity of the fat contents of the milk, being 100, 108 and 103.

A careful study and comparison of the weather conditions of the several years with the tabulated data was made without much enlightenment. The relationship between the drougthy spring of 1899, a scanty pasture growth and lessened milk and butter yield, is clear. Further than this one cannot generalize with safety. The springs of 1897 and of 1902 were each inordinately wet. In one year much more but no better milk was made on pasture; in the other no more but, for a while, considerably better milk was yielded. The springs of 1895 and 1896 were both on the whole rather warmer than normal, while the rainfall ranged from normal to slightly subnormal. In one year much more and much better milk was made on pasture grass than on the barn ration; in the other a greater flow ensued but no better quality.

An endeavor to establish a relationship between the stages of lactation of the cows and these changes in the quality of the milk likewise proved of little avail. The average distances from last calv-

ing and from next calving of the cows of the herds of each year did not seem to be sufficiently unlike to be a factor in the results. At present the reasons why the herd gave no better milk on pasture than in the barn in 1895, 1897 and 1898, are beyond the writer's fathoming. And similarly it may be said that the reasons why the cows gave better milk on pasture than they did in the barn in 1896 and from 1900-1902 are beyond his ken. But the facts are beyond dispute.

Viewing the matter broadly, however, it is clear at any rate that no poorer milk results from pasture feeding—even when the flow is considerably augmented. A better milk and more of it, and seldom a thinner milk, no matter how much more there is of it, was the general outcome of six sets of comparisons given in a former issue.[1] This dictum is abundantly confirmed by the results of the past eight years' work. It shows how irrational is the Vermont law which lowers the milk standard for May and June because of the supposed thinner milk made on pasture feeding. Were it not that the statute in this state is so seldom enforced that it has become practically a dead letter it might be worth while to get the cow's testimony on this point into court.

[1] Vt. Sta. Rpt., 7, pp. 107-109 (1898).

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APPENDIX CONTAINING CONDENSED DATA PERTAINING TO ARTICLE ON FEEDING TRIALS WITH COWS

I. Weights of cows.

II. Average barn temperatures, with ranges and percentages of uniformity.

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IV. Feeding records of the individual cows in feeding tests.

V. Production records; showing production and same per unit for each individual cow in feeding tests.

VI. Difference tables: (*a*) total differences; (*b*) percentage differences.

VII. Results of experimental feeding on different rations.

I. WEIGHTS OF COWS

Period	Goldenrod	Buttercup	Lorna Doone	Kimberley	Viola	Stella	Adelaide	Clare	Max Belle	Lucerne
I begin	1064	1043	....	....	....	....	920	993	906	822
I end	1095	1027	....	....	846	....	927	987	950	822
II	1081	1084	....	....	835	832	933	1012	946	851
III	1115	1053	620	758	832	825	932	991	965	842
IV	1112	1077	632	753	848	828	958	1035	996	860
V	1085	1091	620	761	845	840	942	990	997	853
VI	1090	1080	618	735	813	815	905	943	960	860

Period	Serena	Rosemary	Fresno	Santa Rosa	Eva	Mermaid	Santa Clara	Vermont Una	Pretoria	Pauline
I begin	...	...	835	722	...	...	702	...	852	913
I end	823	857	836	770	865	...	725	...	853	930
II	813	862	807	761	862	...	747	...	870	943
III	810	852	818	772	870	847	779	572	882	932
IV	822	840	823	803	863	827	...	572	911	975
V	827	857	843	825	830	832	...	575	895	987
VI	805	873	803	...	835	785	...	568	933	975

Period	Inez	Pomona	Lady Perusia	Powella	Red Top	Ceres	Flora	Fairie	Sadie	Edith
I begin	...	...	1092	871	1040	...	960	866	818	748
I end	...	862	1129	877	1057	...	943	867	830	777
II	840	832	1134	915	1045	889	948	860	827	795
III	848	813	1165	910	1030	885	970	850	797	792
IV	858	858	1162	...	1067	884	998	870	815	805
V	853	853	1172	...	1030	887	978	855	820	838
VI	830	830	1143	...	1050	900	...	890	820	818

Period	Eunice	Naomi	Primrose	Minta Bella	Rosel	Dorothy	Hallowe'en	Atalanta	Surprise	Jersey Lily
I begin	818	...	...	782	----	...	...	1015	...	582
I end	837	793	913	798	980	...	...	1040	...	603
II	853	812	926	815	1000	727	...	1053	...	642
III	850	847	917	812	1007	728	...	1065	540	653
IV	858	857	930	842	1014	752	848	1109	563	664
V	853	828	900	...	----	768	825	1112	590	692
VI	828	833	875	...	----	773	795	----	553	...

Period	Lavender	Sylvia	Mona	Phyllis	Sonoma	Crystal Girl	Beautina	Max Ella	Haidee	Star Bright
I begin	872	917	917	835	802	---	---	----	---	---
I end	857	945	898	870	811	---	---	----	---	---
II	872	977	937	869	813	---	---	977	---	943
III	892	982	960	885	753	---	963	998	932	947
IV	913	1027	993	890	817	770	943	993	922	960
V	920	----	996	902	845	775	922	1003	935	967
VI	920	----	1028	915	823	783	880	950	913	948

II. AVERAGE BARN TEMPERATURES, WITH RANGES AND PERCENTAGES OF UNIFORMITY

Period number		Average temperature			Range of temperature			Percent of whole within 3° F. of mean			Period number		Average temperature			Range of temperature			Percent of whole within 3° F. of mean		
		5 AM	12 M	6 PM	5 AM	12 M	6 PM	5 AM	12 M	6 PM			5 AM	12 M	6 PM	5 AM	12 M	6 PM	5 AM	12 M	6 PM
		Main barn											*Annex barn*								
I	Pre	56	54	55	45-68	43-63	48-65	33	55	50	I	Pre	57	58	57	45-66	50 63	52-66	33	78	50
	Exp	52	49	52	42-60	36-60	44-58	28	39	55		Exp	53	52	54	40-61	42-60	45-60	39	17	39
II	Pre	55	50	53	45-59	42-56	48-56	70	80	80	II	Pre	54	54	56	42-59	48-59	50-60	60	50	70
	Exp	51	48	51	36-59	41-54	45-57	44	67	67		Exp	53	53	53	40-60	48-58	46-59	50	83	78
III	Pre	50	48	51	45-55	41-57	48-58	80	60	80	III	Pre	53	52	53	50-58	47-55	45-57	90	90	80
	Exp	52	49	51	42-60	43-58	46-57	61	72	72		Exp	53	54	55	48 61	47-60	50-58	72	61	89
IV	Pre	54	53	53	42-62	45-60	46 57	40	20	60	IV	Pre	56	56	57	50-64	50-60	53-60	20	50	90
	Exp	56	54	56	48-60	48-61	50-60	67	61	78		Exp	59	60	60	50-64	45-67	54-64	68	61	78
V	Pre	59	57	58	55-65	52-63	48-64	80	60	60	V	Pre	60	64	60	57-65	58-65	57-65	90	30	80
	Exp	60	60	61	53-68	53-75	55-73	83	67	61		Exp	61	64	62	56-69	56-78	57-75	61	50	44
VI	Pre	62	61	62	58-68	55-72	57-68	80	60	50	VI	Pre	61	64	63	56-66	55-72	58-70	70	60	70
	Exp	60	60	62	47-67	48-74	53-78	39	50	44		Exp	57	63	63	41-65	53-74	50-77	44	72	55

III. ANALYSES AND DIGESTIBLE INGREDIENTS IN FODDERS AND FEEDS

(a) ANALYSES ON DRY BASIS; (b) DIGESTION COEFFICIENTS; (c) POUNDS OF DIGESTIBLE NUTRIENTS IN ONE HUNDRED POUNDS OF ORIGINAL SUBSTANCE.

(a) ANALYSES ON DRY BASIS.

Fodders and feeds	Dates of sampling	Original substance		Composition of dry matter						
		Water	Dry matter	Crude ash	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract	Nitrogen	Phosphoric acid	Potash
Hay, main barn	Dec.-Jan.	10.38	89.62	8.62	11.74	33.51	43.93	2.20	1.88	0.48	2.77
	Feb.-Mar.	12.07	87.93	9.48	12.59	31.69	43.99	2.25	2.01	0.67	3.26
	Apr.-May	11.09	88.91	7.91	10.65	33.00	45.97	2.47	1.70	0.60	2.48
Hay, annex barn	Dec.-Jan.	12.11	87.89	6.85	8.43	36.97	45.90	1.85	1.35	0.49	2.33
	Feb.-Mar.	14.16	85.84	7.63	9.98	36.12	44.14	2.13	1.60	0.67	2.26
	Apr.-May	11.32	88.68	7.96	10.65	33.75	45.62	2.02	1.70	0.65	2.50
Silage (Sanford)	Dec. 11, 23, 30	64.37	35.63	5.82	9.62	19.02	62.36	3.18	1.54	0.55	1.79
(immature)	Jan. 6-8	65.15	34.85	6.15	9.82	20.33	61.16	2.54	1.57	0.63	1.70
	Jan. 13-16	78.20	21.80	7.01	8.85	29.62	53.00	1.52	1.42	0.58	1.91
	Jan. 20	79.96	20.04	6.85	8.21	30.02	53.43	1.49	1.31	0.53	1.93
(Sanford)	Jan. 22-28	76.03	23.97	6.07	9.19	25.38	56.70	2.66	1.47	0.55	1.62
	Jan. 29-31	71.84	28.16	5.98	9.37	20.48	60.87	3.30	1.50	0.63	1.78
	Feb.-Mar.	66.69	33.31	5.14	8.89	16.77	65.89	3.31	1.42	0.58	1.41
	Apr.-May	71.66	28.34	6.15	8.92	20.62	60.96	3.35	1.43	0.63	1.80
Apple pomace silage	Dec.-Jan.	80.65	19.35	4.48	7.84	21.50	59.75	6.43	1.25	0.41	1.19
	" "	80.31	19.69	4.94	8.55	21.50	58.07	6.94	1.37	0.40	1.05
	" "	80.78	19.22	4.73	8.32	22.58	57.66	6.71	1.33	0.39	1.24
	Feb.-Mar.	79.28	20.72	4.89	8.20	21.32	59.04	6.55	1.31	0.40	1.11
	" "	79.25	20.75	4.74	8.21	20.95	59.95	6.15	1.31	0.38	1.10
	" "	79.09	20.91	4.74	8.66	22.07	57.76	6.77	1.39	0.35	1.20
	Apr.	77.79	22.21	4.65	7.95	20.05	60.63	6.72	1.27	0.36	1.07
	"	78.90	21.10	5.21	7.71	20.65	59.85	6.58	1.23	0.34	1.10
	"	77.61	22.39	4.59	9.06	20.45	58.87	7.03	1.45	0.34	1.01
Mixed feed No. 1	Dec. to Feb.	10.70	89.30	6.58	29.96	10.37	47.23	5.86	4.79	2.91	1.67
	Mar. to May	10.95	89.05	6.64	28.97	10.55	47.99	5.85	4.63	2.71	1.69
Mixed feed No. 2	Dec. to Feb.	9.91	90.09	3.71	23.30	10.84	52.64	9.51	3.73	2.21	0.62
	Mar. to May	10.61	89.39	4.40	24.56	9.74	52.57	8.73	3.93	2.14	0.74
Mixed feed No. 3	Dec. to Feb.	10.37	89.63	5.12	25.86	14.40	48.01	6.61	4.15	1.65	0.72
	Mar. to May	9.72	90.28	4.85	26.44	13.56	48.12	6.72	4.28	1.76	0.76
Mixed feed No. 4	Dec. to Feb.	11.77	88.23	7.56	26.72	13.10	49.74	2.88	4.27	2.14	2.14
	Mar. to May	11.32	88.68	7.80	27.69	12.81	48.65	3.05	4.43	2.11	2.26
Mixed feed No. 5	Dec. to Feb.	12.45	87.55	6.87	17.52	10.58	59.91	5.12	2.80	2.4	1.63
	Mar. to May	12.48	87.52	6.90	17.94	11.13	58.80	5.23	2.87	2.52	1.62
Mixed feed No. 6	Dec. to Feb.	12.89	87.11	5.81	25.07	7.79	55.96	5.37	4.01	2.69	1.29
	Mar. to May	11.70	88.30	4.96	25.26	7.42	57.39	5.07	4.04	2.41	1.13
Mixed feed No. 7	Feb. to Mar.	11.12	88.88	5.57	27.41	7.84	54.75	4.43	4.39	2.48	1.18
	Apr. to May	11.13	88.87	5.06	28.70	7.20	54.74	4.30	4.59	2.21	1.03

Fodders and feeds	Dates of sampling	Original substance		Composition of dry matter							
		Water	Dry matter	Crude ash	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract	Nitrogen	Phosphoric acid	Potash
Cottonseed meal	Dec. to Feb.	6.86	93.14	7.18	47.74	8.49	26.70	10.05	7.61	2.80	1.97
	Mar. to May	6.92	93.08	7.37	47.08	8.19	27.30	10.06	7.53	2.66	1.95
Linseed meal	Dec. to Feb.	10.25	89.75	6.84	46.45	8.11	36.06	2.54	7.43	1.96	1.49
	Mar. to May	11.44	88.56	7.00	44.79	8.81	36.14	2.26	7.17	1.98	1.61
King gluten meal	Feb. 5, 17, 24	13.07	86.93	2.45	33.33	1.27	57 61	5.34	5.33	1.06	0.14
	Mar. to May	11.30	88.70	2.45	33.16	1.68	57.56	5.15	5.31	1.09	0.11
King gluten meal	Feb. 5, 17, 24	10.54	89.46	2.84	40.25	1.74	53.08	2.09	6.44	1.07	0.15
	Mar. to May	9.78	90.22	3.06	41.65	1.37	52.24	1.68	6.66	1.03	0.15
Germ oil meal	Dec. to Feb.	10.48	89.52	3.20	24.87	9 43	51.25	11.25	3.98	1.80	0.27
	Mar. to May	10.50	89.50	3.61	26.53	9.31	50.85	9.70	4.24	1.93	0.31
Malt sprouts	Dec. to Feb.	10.92	89.08	7.13	30.26	13.46	47.77	1.38	4.84	1.64	2.28
	Mar. to May	11.52	88.48	7.30	31.58	12.63	46.86	1.63	5.05	1.67	2.43
Dried brewers' grains	Dec. to Feb.	8.85	91.15	4.29	27.34	16.88	45.14	6.35	4.37	0.42	0.15
	Mar. to May	8.72	91.28	4.18	27.80	16.09	45.08	6.76	4.46	0.44	0.16
Wheat bran	Dec. to Feb.	12.25	87.75	7.44	18.77	11.51	56.49	5.79	3.00	3.22	1.93
	Mar. to May	12.40	87.60	6.90	19.75	11.89	56.12	5.34	3.16	3.11	1.71
Ground oats	Dec. to Feb.	12.34	87.66	5.43	13.21	11.91	65.73	3.72	2.11	0.83	0.83
	Mar. to May	12.62	87.38	4.67	14.10	8.64	68.52	4.07	2.26	0.84	0.81

(*b*) DIGESTION COEFFICIENTS*

	Dry matter	Crude protein	Crude fiber	Nitrogen-free extract	Ether extract
Hay †	60	57	58	64	57
Silage ‡	73	63	75	77	82
Silage ¶	66	51	71	67	80
Apple pomace	No basis	for assu mption			
Mixed feed No. 1 §	67	83	39	71	78
" " " 2 §	78	84	60	82	80
" " " 3 §	62	79	47	62	84
" " " 4 §	65	79	31	68	80
" " " 5 §	65	78	26	72	73
" " " 6 and 7 §	71	84	28	76	72
Wheat bran	62	78	29	69	68
Cottonseed meal	74	88	56	61	93
Linseed meal	79	85	80	86	97
Germ oil meal	86	86	78	89	84
Dried brewers' grains	62	79	53	58	91
Malt sprouts	67	80	33	68	100
Ground oats	70	78	20	76	83
King gluten meals	90	88	..	90	94

* From tables of digestibility of American feeding stuffs; Jordan and Hall, Bul. 77 Office Exp. Sta. (1900).

† Assumed to be two-thirds timothy in bloom and one-third red clover.

‡ Mature flint (Sanford) corn, (Jordan and Hall, pp. 77, 83).

§ Calculated from analyses of their ingredients and from digestion coefficients of the same.

¶ Immature corn (Jordan and Hall).

(c) POUNDS OF DIGESTIBLE NUTRIENTS IN ONE HUNDRED POUNDS OF ORIGINAL SUBSTANCE

Fodders and feeds	Digestible nutrients					Nutritive ratio, 1:
	Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
Hay, main barn	53.77	6.00	17.42	25.20	1.12	7.5
	52.76	6.31	16.16	24.77	1.11	6.9
	53.34	5.40	17.02	26.15	1.25	8.5
Hay, annex barn	52.73	4.22	18.85	25.81	0.93	11.1
	51.50	4.89	17.98	24.25	1.04	9.1
	53.21	5.39	17.36	25.89	1.02	8.5
Silage, mature corn	26.01	2.16	5.09	17.11	0.93	11.2
	25.44	2.15	5.32	16.41	0.73	10.8
Silage, immature corn	15.94	1.08	4.37	8.83	0.48	13.2
Silage, mature corn	24.32	1.86	4.19	16.90	0.90	12.5
	20.69	1.59	4.38	13.30	0.78	12.2
Mixed feed No. 1	59.8	22.2	3.6	29.9	4.1	1.9
	59.6	21.4	3.7	30.3	4.1	2.0
Mixed feed No. 2	70.3	17.6	5.9	38.9	6.9	3.4
	69.7	18.5	5.2	38.5	6.2	3.1
Mixed feed No. 3	55.6	18.3	6.1	26.7	5.0	2.4
	56.0	19.0	5.8	27.0	5.1	2.3
Mixed feed No. 4	57.3	18.6	3.6	29 9	2.0	2.1
	57.7	19.4	3.5	29.3	2.2	1.9
Mixed feed No. 5	56.9	11.9	2.4	37.7	3.3	4.0
	56.9	12.2	2.5	37.1	3.3	3.9
Mixed feed No. 6	61.8	18.3	1.9	37.1	3 4	2.6
	62.7	18.7	1.8	38.5	3.2	2.5
Mixed feed No. 7	63.1	20.5	2.0	37.0	2.8	2.2
	63.1	21.4	1.8	37.0	2.8	2.1
Cottonseed meal	68.9	39.4	4.5	14.8	8.8	1.0
	68.9	38.6	4.3	15 4	8.7	1.0
Linseed meal	70.9	35 8	5.9	27.3	2.2	1.1
	70.0	34.3	6.3	27.5	2.0	1.1
King gluten meal (low in protein)	78.2	26.1	....	44.3	4.5	2.1
	79.8	26.0	....	44.9	4.3	2.1
King gluten meal (high in protein)	80.6	32.2	....	42.1	1.8	1.4
	81.2	33.3	....	42.1	1.4	1.4
Germ oil meal	77.0	19.4	6.7	40.3	8.6	3.4
	77.0	20.5	6.5	40.3	7.3	3.1
Malt sprouts	59.7	21.9	4.0	28.1	1.2	1.6
	59.3	22.1	3.7	28.6	1.4	1.7
Dried brewers' grains	56.5	19.8	8.3	23.5	5.3	2.2
	56.6	20.2	7.8	23.7	5.6	2.2
Wheat bran	54.4	13.0	3.0	34.2	3.5	3.5
	54.3	13.5	3.0	33.6	3.2	3.2
Ground oats	61.4	9.2	2.1	43.3	2.8	5.6
	61.2	9.7	1.5	45.2	3.0	5.5

IV. FEEDING RECORDS OF INDIVIDUAL COWS

Name of cow	Low, medium and high feeding / Period numbers	Nature of ration, (No. 2)	Pounds eaten of: Hay	Silage	Wheat bran	Germ oil meal	Corn meal	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental feed	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1:
GOLDENROD	I. Pre.	Medium	145	240	29	49	2	273.5	71.2	196.0	27.5	41.9	109.2	9.1	6.2
	Exp.	"	248	425	48	96		515.9	128.6	345.1	49.4	73.3	191.2	16.6	6.1
	II. Pre.	Low	143	236	15	29		251.1	39.0	168.0	20.4	40.0	91.9	6.2	7.2
	Exp.	"	260	535	24	47		429.6	63.3	275.1	33.9	72.8	140.4	10.3	7.0
	III. Pre.	Medium	146	239	26	51		268.6	68.5	189.5	27.2	38.2	106.6	9.1	6.1
	Exp.	"	256	430	48	95		520.5	126.3	340.2	49.3	67.9	191.8	16.6	6.0
	IV. Pre.	Low	153	240	13	27		249.9	35.8	167.2	21.5	36.9	93.9	6.3	6.8
	Exp.	"	259	428	24	48		420.7	63.4	291.1	37.6	63.6	164.3	11.2	6.7
	V. Pre.	Medium	118	235	26	52		246.8	69.4	165.9	24.5	34.4	92.2	8.2	5.9
	Exp.	"	258	431	47	95		484.6	125.4	325.7	47.1	70.1	179.6	15.5	6.1
	VI. Pre.	Low	123	240	13	27		216.6	35.8	143.1	17.9	33.5	79.6	6.0	7.1
	Exp.	"	230	430	24	48		387.9	64.1	261.8	32.6	61.7	145.2	10.8	7.1
BUTTERCUP	I. Pre.	Low	198	240	14	25	1	286.0	35.5	196.8	23.9	48.9	106.7	7.1	7.2
	Exp.	"	350	432	23	47		543.6	62.5	349.7	42.7	87.0	189.3	12.7	7.2
	II. Pre.	"	196	240	13	27		296.2	35.5	194.6	24.0	49.2	104.3	6.7	7.0
	Exp.	"	348	551	24	48		512.2	64.2	325.6	39.5	88.9	164.4	11.4	7.1
	III. Pre.	"	197	240	13	27		281.1	35.6	190.6	23 9	44.3	105.0	7.1	6.9
	Exp.	"	353	432	24	48		543.4	63 6	342.0	42.9	79.5	188.6	12.7	6.9
	IV. Pre.	"	200	240	13	27		290.7	35.8	192.0	24.5	44.5	105.6	6.8	6.8
	Exp.	"	357	432	24	48		508.4	64.3	343.8	43.8	79.7	189.3	12.3	6.8
	V. Pre.	"	192	240	13	27		279.6	35.6	179.8	21.6	45.2	97.6	6.9	7.3
	Exp.	"	353	432	24	48		507.3	63.6	327.8	39.3	82.7	177.7	12.4	7.3
	VI. Pre.	"	189	240	13	27		275.6	35.8	178.3	21.4	44.7	96 [illegible]	6.8	7.3
	Exp.	"	351	432	24	48		496.8	64.2	326.7	39.1	82.3	177.1	12.4	7.3
LORNA D'NE	IV. Pre.	Medium	70	159	19	38		164.9	51.1	115.4	17.9	21.0	66.2	5.7	5.6
	Exp.	"	117	283	35	70		280.2	93.8	203.8	32.1	36.3	117.3	10.4	5.5
	V. Pre.	Low	74	157	10	20		141.0	26.7	92.8	12.1	21.0	51.8	4.0	6.8
	Exp.	"	134	288	18	36		253.7	47.7	168.6	21.8	38.2	94.2	7.3	6.8
	VI. Pre.	Medium	70	159	18	35		157.0	49.2	107.1	19.1	21.6	59.9	5.4	5.8
	Exp.	"	126	287	35	71		285.9	94.5	200.5	31.0	39.5	112.0	10.5	5.7
KIMBERLEY	IV. Pre.	Low	113	200	13	25		199.8	34.0	134.8	17.9	28.7	76.5	5.4	6.6
	Exp.	"	190	358	24	48		338.9	64.3	237.6	32.0	49.5	135.3	9.8	6.5
	V. Pre.	"	108	195	11	23		187.2	30.3	121.7	15.2	28.7	67.3	5.0	7.1
	Exp.	"	196	356	21	42		337.2	55.6	222.1	27.9	52.3	123.0	9.2	7.0
	VI. Pre.	"	108	200	13	26		190.5	34.9	126.2	16.1	29.2	69.9	5.4	6.9
	Exp.	"	200	360	23	46		339.1	61.4	225.8	29.3	53.4	126.9	9 7	6.9
VIOLA	II. Pre.	Medium	106	237	31	44	5*	250.2	70.8	171.6	24.8	35.3	96.6	7.9	6.1
	Exp'	"	205	544	48	95		447.7	127.6	297.5	43.4	67.9	155.3	14.7	5.9
	III. Pre.	Low	115	239	13	27		208.3	35.6	147.1	18.7	31.0	84.5	6.2	6.9
	Exp.	"	210	432	24	48		418.2	63.6	266.4	33.9	56.4	153.1	11.2	6.9
	IV. Pre.	Medium	116	240	26	51		250.9	69.0	173.4	26.0	32.9	99 0	8.2	5.8
	Exp.	"	202	432	48	96		436.0	128.6	312.2	47.4	58.3	178.6	15.1	5.7
	V. Pre.	Low	109	240	13	27		206.7	35.6	135.6	17.1	31.1	75.9	5.8	7.0
	Exp.	"	205	432	24	48		377.0	63.6	249.4	31.3	57.7	139.2	10.5	7.0
	VI. Pre.	Medium	100	238	25	51		227.7	68.0	155.6	23.2	31.4	87.1	7.9	5.9
	Exp.	"	194	432	47	94		417.6	125.7	291.1	43.4	59.2	162.6	14.6	5.9

*Ground oats.

Name of cow	Low, medium and high feeeing / Period numbers	Nature of ration, (No. 2)	Pounds eaten of: Hay	Silage	Wheat bran	Germ oil meal	Corn meal	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental feed	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1:
STELLA	II. Pre.	Medium													
	Exp.	"	191	545	47	93		432.9	124.9	286.0	38.6	68.2	151.9	14.0	6.5
	III. Pre.	"	113	240	27	53		242.5	71.2	172.9	24.1	35.1	99.1	8.8	6.4
	Exp.	"	196	428	47	95		463.5	125.4	304.7	42.6	61.6	175.2	15.6	6.4
	IV. Pre.	"	111	239	27	53		247.7	71.7	171.3	24.7	34.2	98.2	8.2	6.1
	Exp.	"	205	432	48	96		436.2	128.6	311.1	44.7	62.5	178.3	14.9	6.1
	V. Pre.	"	109	238	27	53		241.6	71.2	163.1	24.5	33.6	90.7	7.9	5.8
	Exp.	"	207	431	48	96		441.2	127.2	299.7	44.7	62.4	166.4	14.4	5.9
	VI. Pre.	"	113	239	27	53		243.2	71.6	165.4	24.7	34.3	91.9	8.0	5.8
	Exp.	"	206	431	48	95		429.9	127.5	298.5	44.4	62.2	165.7	14.3	5.9
ADELAIDE	I. Pre.	Medium	119	240	29	49	2	249.8	71.2	180.7	23.8	39.2	103.3	8.6	6.8
	Exp.	"	201	428	45	91		467.8	121.4	312.7	41.6	67.8	178.0	15.2	6.7
	II. Pre.	High	109	240	31	63		266.5	83.4	184.5	26.3	38.9	104.1	9.2	6.2
	Exp.	"	195	542	66	131		486.5	175.7	327.6	48.7	72.2	174.8	17.2	5.9
	III. Pre.	Medium	115	240	25	48		238.0	65.0	168.9	22.9	35.1	96.9	8.4	5.6
	Exp.	"	200	413	48	96		462.7	127.2	304.5	42.8	61.8	174.4	15.7	6.3
	IV. Pre.	High	110	240	34	68		266.9	91.4	186.3	28.7	35.2	106.6	9.6	5.7
	Exp.	"	187	427	55	110		437.7	147.3	315.2	47.6	60.1	181.1	15.9	5.8
	V. Pre.	Medium	100	232	20	40		214.0	53.4	143.0	20.2	30.7	79.9	6.5	6.2
	Exp.	"	184	422	34	69		381.8	90.9	257.1	35.7	55.9	143.5	11.5	6.3
	VI. Pre.	High	100	236	27	54		231.7	72.5	158.5	24.1	32.0	88.5	7.9	5.7
	Exp.	"	174	415	57	114		421.3	152.4	297.7	47.6	57.4	166.1	15.6	5.4
CLARE	I. Pre.	Medium	115	240	29	49	2	246.2	71.2	179.9	25.7	36.7	101.6	8.8	6.2
	Exp.	"	199	428	47	95		471.4	126.8	318.1	46.2	64.8	178.6	16.0	6.1
	II. Pre.	"	107	239	27	53		252.0	71.0	174.6	25.6	36.1	97.3	8.4	5.9
	Exp.	"	201	546	48	95		444.7	127.6	295.6	43.1	67.3	154.5	14.7	5.9
	III. Pre.	"	115	240	26	53		243.3	70.3	174.7	25.6	33.4	99.8	8.9	6.0
	Exp.	"	201	432	48	96		473.9	127.2	312.3	46.0	59.2	178.9	16.0	6.0
	IV. Pre.	"	113	240	27	53		251.0	71.7	174.0	26.4	32.5	99.4	8.4	5.7
	Exp.	"	202	431	48	96		435.7	128.6	312 0	47.4	58.3	178.4	15.0	5.7
	V. Pre.	"	106	240	27	53		239.7	71.2	161.9	24.3	32.7	90.5	8.2	5.8
	Exp.	"	200	432	48	96		435.3	127.2	296.4	44.3	60.4	165.3	14.9	5.9
	VI. Pre.	"	105	240	27	53		236.4	71.6	161.4	24.3	32.5	90.2	8.2	5.8
	Exp.	"	179	432	47	94		403.6	125.6	283.1	42.6	56.7	158.7	14.4	5.8
MAX BELLE	I. Pre.	High	110	240	34	59	2	254.9	84.5	187.8	28.1	36.7	106.2	9.8	5.9
	Exp.	"	198	425	70	140		530.1	187.5	364.4	58.0	68.5	204.3	20.6	5.5
	II. Pre.	Medium	114	227	27	55		255.7	72.7	176.7	26.2	36.8	97.9	8.6	5.9
	Exp.	"	206	541	47	93		445.1	124.9	295.4	42.8	67.7	154.1	14.5	6.0
	III. Pre.	High	114	239	38	76		273.4	101.5	198.5	31.7	35.2	113.0	11.3	5.5
	Exp.	"	193	418	68	136		514.3	180.1	346.7	55.8	60.8	197.9	20.0	5.4
	IV. Pre.	Medium	113	240	27	53		251.0	71.7	174.0	26.4	32.5	99.4	8.4	5.7
	Exp.	"	205	429	48	95		436.8	127.7	312.3	47.4	58.6	178.4	15.0	5.9
	V. Pre.	High	108	233	38	77		271 3	102.4	186.0	30.8	34.5	103.6	10.4	5.2
	Exp.	"	190	421	68	136		476.0	180.1	330.6	54.7	61.4	184.3	18.4	5.3
	VI. Pre.	Medium	106	237	26	51		233.6	68.9	152.3	23.7	32.4	88.9	8.0	5.9
	Exp.	"	192	429	48	95		416.8	127.5	290.8	43.7	58.9	162.4	14.7	5.8

Name of cow	Low, medium and high feeding / Period numbers	Nature of ration, (No. 2)	Pounds eaten of: Hay	Silage	Wheat bran	Germ oil meal	Corn meal	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental feed	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1:
LUCERNE	I. Pre.	High	106	225	33	57	2	244.2	81.5	178.5	25.1	36.7	102.1	9.2	6.4
	Exp.	"	190	401	58	115		480.6	154.5	325.8	47.1	66.5	184.9	17.4	6.2
	II. Pre.	"	109	229	34	68		269.7	90.5	187.3	27.5	38.8	105.4	9.7	6.1
	Exp.	"	194	530	66	132		483.4	176.6	325.8	48.7	71.5	173.8	18.0	5.9
	III. Pre.	"	114	239	37	75		271.6	99.7	195.6	29.8	37.1	111.7	11.0	5.8
	Exp.	"	195	424	65	130		508.8	172.2	340.4	51.8	64.4	194.9	19.2	5.8
	IV. Pre.	"	113	240	37	75		278.5	100.4	194.8	30.7	36.2	111.1	10.2	5 6
	Exp.	"	201	430	64	129		475.8	172.3	342.6	53.6	64.2	195.8	17.9	5.6
	V. Pre.	"	106	232	35	70		259.2	93.3	177.6	28.8	34.1	98.7	9.4	5.3
	Exp.	"	189	424	60	120		454.9	158.9	313.8	50.3	60.8	173.6	16.4	5.4
	VI. Pre.	"	100	233	32	63		243.3	85.0	167.6	26.7	32.5	93.5	8.7	5.5
	Exp.	"	181	423	56	112		427.6	149.8	301.0	47.6	58.8	167.8	15.5	5.5
SERENA	II. Pre.	Medium	112	237	27	35	5*	244.2	59.5	166.1	24.3	35.8	91.8	7.2	5.9
	Exp.	"	209	547	45	90		444.7	120.4	294.5	42.2	68.2	153.5	14.3	6.0
	III. Pre.	High	111	240	34	68		259.3	89.8	188.7	29.4	34.1	107.8	10.4	5.5
	Exp.	"	192	428	62	124		501.5	164.2	333.1	52.8	60.0	192.3	18.8	5 6
	IV. Pre.	Medium	116	240	26	51		250.9	69.0	173.4	26.0	32.9	99.0	8.2	5.8
	Exp.	"	211	431	43	86		430.2	115.2	306.2	45.2	59.0	174.8	14.2	5.9
	V. Pre.	High	101	214	39	78		259.9	104.0	179.6	30.5	32.6	100.0	10.2	5.1
	Exp.	"	188	425	53	106		435.8	140.4	299.0	46.3	58.9	167.0	15.6	5.6
	VI. Pre.	Medium	105	240	25	49		231.0	66.2	157.2	23.2	32.2	87.9	7.8	5.9
	Exp.	"	190	432	40	78		393.5	105.2	272.9	39.0	57.4	152.7	13.2	6.2
ROSEMARY	II. Pre.	High	94	235	35	58	4*	254.0	86.1	176.5	26.5	35.8	99.6	9.0	5.9
	Exp.	"	182	541	67	134		478.3	179.3	323.3	48.9	69.9	172.9	16.1	5.8
	III. Pre.	"	112	239	39	77		273.3	103.2	197.4	30.4	37.0	112.7	11.3	5.8
	Exp.	"	199	428	69	138		523.4	182.8	351.9	54.1	66.0	201.2	20.1	5.8
	IV. Pre.	"	111	240	39	78		281.1	104.8	197.2	31.5	36.1	113.0	10.5	5.5
	Exp.	"	193	432	64	129		469.4	172.3	339.0	53.2	62.9	194.2	17.8	5.6
	V. Pre.	"	111	239	37	74		271.3	98.8	186.0	30.3	35.6	103.3	9.9	5.3
	Exp.	"	196	430	64	128		473.5	169.5	327.1	52.9	62.9	181.9	17.2	5.4
	VI. Pre.	"	108	238	35	71		261.7	94.9	180.7	29.2	34.7	100.4	9.5	5.4
	Exp.	"	192	430	62	123		454.5	164.9	320.0	51.4	61.9	178.2	16.8	5.4

* ½ cottonseed meal, ½ linseed.

Name of cow	Low, medium and high feeding / Period numbers	Nature of ration (No. 3)	Pounds eaten of					Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental fodder	Pounds of digestible nutrients eaten during period					Nutritive ratio, 1 :
			Hay	Silage	Wheat bran	Dried brewers' grains	Corn meal			Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
FRESNO	I. Pre.	Medium	113	238	29	49	2	244.3	78.8	167.5	26.1	36.4	91.7	7.3	5.6
	Exp.	"	192	430	47	96		467.6	128.4	294.6	47.0	64.0	160.1	13.3	5.4
	II. Pre.	Low	107	228	12	23		208.3	31.3	135.1	17.7	32.9	73.7	4.6	6.6
	Exp.	"	206	546	23	46		382.8	61.3	236.3	30.9	63.9	118.5	8.3	6.5
	III. Pre.	Medium	109	240	26	51		235.8	68.1	158.9	25.4	32.4	88.2	7.2	5.4
	Exp.	"	203	432	48	96		476.6	128.2	292.4	47.2	59.8	161.8	13.3	5.3
	IV. Pre.	Low	111	240	13	27		213.8	36.2	139.9	19.1	30.4	78.9	5.4	6.4
	Exp.	"	205	432	24	48		374.7	64.8	254.3	34.6	55.5	143.3	9.8	6.4
	V. Pre.	Medium	105	238	26	52		237.5	70.6	147.7	24.3	32.8	80.2	7.2	5.3
	Exp.	"	194	430	48	95		431.3	129.1	273.8	44.5	60.1	146.6	13.2	5.3
	VI. Pre.	Low	107	239	13	27		202.4	36.1	129.3	17.2	31.0	70.6	5.3	6.6
	Exp.	"	194	432	24	48		356.8	64.9	233.8	31.0	56.1	127.7	9.6	6.6
SANTA ROSA	I. Pre.	Low	105	239	13	27		201.5	35.9	140.8	18.8	32.9	78.0	5.4	6.6
	Exp.	"	182	423	24	47		391.2	63.7	247.4	33.1	57.5	137.2	9.5	6.5
	II. Pre.	"	106	225	13	27		210.9	35.7	136.5	18.5	32.9	74.3	4.8	6.4
	Exp.	"	199	532	23	47		373.9	62.2	230.9	30.5	62.2	115.8	8.2	6.4
	III. Pre.	"	114	240	13	25		205.8	33.6	139.8	18.6	30.9	79.0	5.3	6.6
	Exp.	"	206	432	24	47		414.3	63.2	253.4	34.0	55.8	143.1	9.7	6.5
	IV. Pre.	"	117	240	13	27		219.0	36.2	143.1	19.4	31.3	80.4	5.5	6.4
	Exp.	"	206	432	24	48		375.7	64.8	254.9	34.7	55.7	143.5	9.8	6.4
	V. Pre.	"	110	240	13	27		208.2	36.2	131.0	17.4	31.5	71.5	5.3	6.6
	Exp.	"	204	429	24	48		375.7	65.0	238.5	31.5	57.7	130.0	9.7	6.6
EVA	II. Pre.	Low	109	231	11	16	2	206.7	26.8	133.8	17.0	32.9	73.3	4.3	6.8
	Exp.	"	200	550	20	39		369.7	52.5	228.1	28.7	62.4	114.7	7.8	6.8
	III. Pre.	Medium	112	240	25	49		235.8	65.4	158.7	25.1	32.7	88.1	7.1	5.5
	Exp.	"	207	432	48	96		480.1	128.2	294.5	47.4	60.4	162.8	13.4	5.3
	IV. Pre.	Low	108	240	13	27		211.2	36.2	138.3	18.9	29.9	78.1	5.4	6.4
	Exp.	"	209	432	24	48		378.2	64.8	256.5	34.9	56.1	144.3	9.9	6.4
	V. Pre.	Medium	103	240	26	51		240.8	69.7	151.5	24.3	33.5	81.3	7.2	5.4
	Exp.	"	204	431	48	96		441.3	130.0	279.8	45.2	61.9	149.7	13.4	5.3
	VI. Pre.	Low	109	240	13	27		204.4	36.1	131.0	17.3	31.4	71.3	5.3	6.6
	Exp.	"	199	432	23	47		359.5	63.1	235.3	30.9	56.8	128.5	9.5	6.7
MERMAID	IV. Pre.	Low	112	240	13	27		213.4	36.2	139.0	17.6	32.5	78.6	5.3	7.0
	Exp.	"	209	432	24	48		375.8	64.8	253.7	32.0	59.9	143.2	9.7	7.0
	V. Pre.	"	114	240	13	27		211.7	36.2	133.0	17.6	32.7	72.3	5.1	6.6
	Exp.	"	212	432	24	48		383.7	65.0	243.2	32.0	60.0	131.8	9.2	6.6
	VI. Pre.	"	115	240	13	27		209.8	36.1	133.6	17.6	32.8	72.5	5.1	6.6
	Exp.	"	206	432	24	48		367.6	64.9	240.0	31.7	58.9	130.3	9.1	6.6
S'TA CLARA	I. Pre.	Medium	105	199	14	25	3	191.7	37.8	131.9	17.9	30.7	72.6	5.0	6.4
	Exp.	"	181	351	28	57		374.8	76.3	236.0	34.0	54.6	128.4	9.5	6.0
	II. Pre.	"	105	182	12	25		199.1	40.2	129.5	19.0	30.8	69.3	4.8	5.8
	Exp.	"	202	440	34	67		386.6	89.8	235.1	35.4	60.5	116.7	9.4	5.6
	III. Pre.	"	111	198	15	23		195.8	38.8	126.3	17.1	28.4	70.3	4.8	6.4
	Exp.	"	193	358	35	71		404.8	94.3	247.9	38.2	52.7	136.7	10.6	5.6

Name of cow	Low, medium and high feeding / Period numbers	Nature of ration (No. 3)	Pounds eaten of: Hay	Silage	Wheat bran	Dried brewers' grains	Corn meal	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental fodder	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1:
VT. UNA	IV. Pre.	Low	73	156	13	27		151.5	36.2	99.2	15.1	20.7	55.3	4.2	5.7
	Exp.	"	134	288	24	48		267.5	64.8	181.8	27.5	38.0	101.4	7.7	5.7
	V. Pre.	"	71	160	13	27	1	148.7	36.2	93.7	14.0	21.4	50.7	4.2	5.8
	Exp.	"	133	288	24	48		270.1	65 0	171.5	25.4	39.4	92.6	7.7	5.9
	VI. Pre.	"	71	160	13	27		146.9	36.1	93.7	14.0	21.4	50.7	4.2	5.8
	Exp.	"	134	288	24	48		263.7	64.9	172.0	25.5	39.6	92.9	7.7	5.9
PRETORIA	I. Pre.	Low	113	239	9	14	1	194.4	21.6	136.5	16.1	33.2	76.4	4.6	7.5
	Exp.	"	194	431	22	43		399.7	58.4	252.6	32.9	59.7	140.0	9.4	6.7
	II. Pre.	Medium	112	237	23	47		247.2	62.5	159.4	24.6	36.4	85.8	6.5	5.6
	Exp.	"	197	534	44	89		428.8	118.3	265.1	41.9	65.7	132.3	11.4	5.4
	III. Pre.	Low	112	238	12	25		202.5	32.7	137.7	18.3	30.4	77.9	5.2	6.6
	Exp.	"	199	431	24	47		407.7	63.2	249.5	33.6	54.6	141.2	9.6	6.5
	IV. Pre.	Medium	111	239	24	49		243.3	66.0	158.4	25.3	32.2	87.6	7.1	5.4
	Exp.	"	199	430	40	80		412.1	108.0	278.0	43.3	57.2	154.4	12.2	5.5
	V. Pre.	Low	98	239	11	23		191.8	30.8	121.0	15 6	29.1	66.6	4.9	6.8
	Exp.	"	200	430	22	45		368.0	60.5	233.7	30.4	56.7	127.7	9.4	6.8
	VI. Pre.	Medium	102	239	23	47		224.9	63.1	143.7	22.6	31.9	77.4	6.8	5.5
	Exp.	"	189	430	40	70		395.0	108.1	258.0	39.9	57.9	139.1	11.9	5.6
PAULINE	I. Pre.	Medium	115	236	29	41	2	246.4	72.6	168.1	26.2	36.6	91.9	7.3	5.6
	Exp.	"	202	413	48	96		470.8	129.3	296.2	47.4	65.0	160.0	13.3	5.4
	II. Pre.	"	111	221	27	53		249.5	71.4	160.4	26.1	36.0	85.6	6.8	5.3
	Exp.	"	200	534	47	95		439.6	126.5	271.8	43.8	66.8	135.5	11.9	5.2
	III. Pre.	"	112	236	27	53		239.9	70.7	161.0	26.1	32.9	89.0	7.4	5.3
	Exp.	"	202	416	48	96		469.5	128.2	288.0	46.8	58.9	158.9	13.2	5.3
	IV. Pre.	"	115	238	27	53		252.6	72.3	164.2	26.9	33.2	90.3	7.5	5.2
	Exp.	"	202	425	48	96		434.9	129.6	292.0	48.0	58.9	160.8	13.4	5 2
	V. Pre.	"	110	226	27	53		240.0	72.4	150.9	24.7	33.2	80.5	7.3	5.3
	Exp.	"	208	410	48	96		438.5	130.0	277.5	45.1	61.7	147.9	13.2	5.3
	VI. Pre.	"	106	235	27	53		236.3	72.2	150.6	24.7	33.0	80.6	7.3	5.3
	Exp.	"	193	421	48	96		417.7	129.7	271.9	44.5	59.6	145.4	13.1	5.3
INEZ	III. Pre.	Medium	115	239	30	47	3*	243.5	70.8	163.9	26.7	33.3	90.6	7.3	5.3
	Exp.	"	208	432	48	96		478.8	126.0	295.0	47.5	60.6	163.0	13.4	5.3
	IV. Pre.	High	117	240	39	78		288.6	105.8	186.9	34.1	35.8	101.2	9.4	4.6
	Exp.	"	197	430	72	144		496.8	194.4	331.5	61.5	62.5	179.9	17.1	4.6
	V. Pre.	Medium	110	240	27	53		244.4	72 4	153.7	25.0	33.9	82.3	7.4	5.3
	Exp.	"	206	432	48	96		443.4	130.0	281.1	45.4	62.3	150.3	13.4	5.4
	VI. Pre.	High	105	234	39	77		267.7	104.6	170.4	37.4	34.8	90.0	9.1	4.6
	Exp.	"	184	420	64	129		453.5	173.9	294.8	53.3	60.9	156.2	15.5	4.7
POMONA	II. Pre.	Medium	94	231	29	46	3*	236.2	69.7	152.1	23.6	34.6	83.3	5.4	5.6
	Exp.	"	198	540	45	90		433.0	120.2	265.5	38.9	69.3	134.8	11.1	5.9
	III. Pre.	"	115	240	27	53		243.7	70.7	162.2	24.7	35.6	89.9	7.3	5.7
	Exp.	"	207	428	48	96		475.7	128.2	290 8	44.5	64.0	161.1	13.1	5.7
	IV. Pre.	"	115	240	27	53		252.1	72.3	163.2	25.3	35.4	90.1	7.4	5.6
	Exp.	"	198	432	48	96		431.1	129.6	289.0	45.1	62.1	160.0	13.2	5.6
	V. Pre.	"	108	237	26	52		239 8	70.6	151.0	24.4	33.7	80.6	6.9	5.3
	Exp.	"	201	432	48	96		439.0	130.0	278.2	45.1	62.2	148.4	12.7	5.3
	VI. Pre.	"	105	237	27	53		236.2	72 2	150.5	24.6	33.3	80.3	7.0	5.3
	Exp.	"	198	430	46	92		419.3	124.3	272.8	43.8	61 3	145.7	12.4	5.4

* ½ cottonseed meal, ½ linseed.

Name of cow	Low, medium and high feeding / Period numbers	Nature of ration, (No. 3)	Pounds eaten of					Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental fodder	Pounds of digestible nutrients eaten during period					
			Hay	Silage	Wheat bran	Dried brewers' grains	Corn meal			Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1:
LADY PERUSIA	I. Pre.	High	111	240	36	65	2	263.7	92.4	179.7	30.2	37.6	97.7	8.5	5.1
	Exp.	"	191	405	70	141		518.1	189.5	325.4	58.8	66.7	173.8	16.4	4.7
	II. Pre.	Medium	107	222	28	55		249.0	74.1	160.2	26.4	35.5	85.6	7.0	5.2
	Exp.	"	195	526	47	96		434.0	127.3	268.4	43.6	65.7	133.8	11.8	5.2
	III. Pre.	High	104	237	38	76		263.2	100.8	176.0	31.8	33.7	96.3	8.9	4.7
	Exp.	"	191	418	72	144		524.6	192.2	322.5	59.3	61.6	175.7	16.7	4.6
	IV. Pre.	Medium	110	234	27	53		247.0	72.3	160.5	26.5	32.3	88.4	7.4	5.2
	Exp.	"	203	428	48	96		436.6	129.6	293.2	48.1	59.2	161.6	13.4	5.2
	V. Pre.	High	108	236	39	77		274.8	105.0	172.5	31.6	35.4	91.0	9.2	4.7
	Exp.	"	192	411	68	137		479.7	185.1	304.0	55.9	62.5	160.3	16.2	4.6
	VI. Pre.	Medium	103	239	26	52		233.1	70.4	148.8	24.2	32.5	79.8	7.2	5.3
	Exp.	"	182	427	48	96		409.4	129.7	267.3	44.0	58.0	142.9	13.0	5.2
POWELLA	I. Pre.	High	93	240	37	66	2	249.1	94.2	170.1	27.8	35.9	94.3	8.2	5.3
	Exp.	"	171	422	72	143		510.4	193.1	319.3	55.7	67.9	173.7	16.2	5.0
	II. Pre.	"	89	239	40	80		272.2	107.2	174.4	30.8	36.9	94.2	8.5	4.9
	Exp.	"	162	543	71	142		471.6	189.7	290.4	51.6	67.3	146.6	14.7	4.8
	III. Pre.	"	92	23	40	79		257.0	105.2	171.3	30.7	33.8	94.2	9.0	4.8
	Exp.	"	176	429	67	133		499.2	178.0	306.2	53.7	61.9	168.7	15.6	5.0
RED TOP	I. Pre.	Medium	151	239	29	49	2	279.1	71.7	188.1	28.4	43.1	101.5	7.8	5.7
	Exp.	"	263	429	48	96		531.5	129.3	333.1	51.4	76 4	178.1	14.1	5.6
	II. Pre.	High	141	236	38	75		311.2	100.9	198.8	34.2	44.0	104.4	8.9	4.9
	Exp.	"	253	520	71	142		545.8	189.6	337.5	59.8	79.7	166.6	15.9	4.7
	III. Pre.	Medium	144	238	27	53		268.8	70.7	178.5	28.1	38.2	97.3	9.1	5.5
	Exp.	"	261	418	48	96		521.9	128.2	319.5	50.6	68.5	173.8	13.8	5.4
	IV. Pre.	High	143	233	39	78		308.9	105.8	198.8	35.6	39.7	106.4	9.6	4.7
	Exp.	"	244	426	69	138		528.9	186.3	350.2	63.2	69.4	188.4	17.1	4.7
	V. Pre.	Medium	129	239	25	51		257.1	68.8	161.5	25.2	36.8	86.1	7.4	5.5
	Exp.	"	253	423	48	95		481.1	129.1	303.7	47.6	69.8	161.2	13.9	5.5
	VI. Pre.	High	130	229	38	76		286.7	102.8	181.6	32.3	38.7	95.3	9.3	4.8
	Exp.	"	236	426	61	123		493.9	165.8	318.7	54.5	69.5	168.2	15.8	5.0
CERES	III. Pre.	High	117	240	45	59	9*	274.8	100.0	184.2	33.5	35.3	100.6	8.9	4.7
	Exp.	"	190	426	59	118		491.8	157.5	302.3	52.3	59.4	166.4	14.8	5.0
	IV. Pre.	"	113	239	29	57		256.7	77.7	166.9	27.9	33.3	91.6	7.8	5.1
	Exp.	"	209	432	65	129		488.1	174.6	325.9	58.1	63.2	152 4	16.1	4.3
	V. Pre.	"	104	225	40	80		270.6	108.6	170.3	32.0	34.5	89.6	9.2	4.5
	Exp.	"	205	431	68	135		495.5	183 3	314.0	56.5	65.5	165.8	16.4	4.8
	VI. Pre.	"	113	229	40	80		276.9	108.2	175.9	32.5	36.2	92.5	9.4	4.6
	Exp.	"	203	432	67	134		480.7	181.1	312.0	56.0	65.1	164.9	16.3	4 8

Name of cow	Malt sprouts vs. cottonseed and linseed meals / Period numbers	Nature of ration (Nos. 1 and 4)	Pounds eaten of: Hay	Silage	Wheat bran	½ cottonseed meal ½ linseed meal	Malt sprouts	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental fodder	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
FLORA	I. Pre.	No. 1	111	239	54	24	2	242.5	71.5	169.8	28.9	34.2	93.8	6.7	5 0
	Exp.	"	194	431	96	48	--	470.0	128.7	302.6	52.9	60.9	165.7	12.0	4.8
	II. Pre.	No. 4	103	233	37	7	13	225.0	50.0	147.9	22.5	32.4	81.3	4.4	5.5
	Exp.	"	190	541	37	--	74	403.8	97.7	252.1	37.9	60.7	128.8	6.9	5.4
	III. Pre.	No. 1	106	240	51	25	4	236.1	71.0	162.2	28.7	30.1	90.8	6.5	4.7
	Exp.	"	188	432	96	48	--	463.5	128.2	292.5	51.8	53.7	162.7	11.9	4.7
	IV. Pre.	No. 4	103	240	27	6	33	228.8	58.2	151.4	24.1	29.1	85.6	5.1	5.2
	Exp.	"	190	427	40	--	79	400.3	105.0	272.9	43.0	52.8	153.2	8.6	5.2
	V. Pre.	No. 1	99	237	51	25	3	231.4	70.1	148.8	25.9	30.1	81.4	6.3	4.9
	Exp.	"	191	429	96	48	--	427.1	127.9	276.4	48.0	56.6	150.7	11.7	4.9
FAIRIE	I. Pre.	No. 4	116	239	27		39†	236.7	61.1	162.6	24 7	36.1	88.6	6.5	5.6
	Exp.	"	194	407	43		79†	446.7	114.6	284.0	44.4	59.4	156.8	9.8	5.4
	II. Pre.	"	112	220	24		48	232.3	63.6	157.5	24.8	33.8	85.9	4.3	5.2
	Exp.	"	196	535	42		85	421.7	111.8	263.6	41.2	62.1	134.6	7.3	5.2
	III. Pre.	"	110	235	25		50	233.1	66.0	158.4	25.3	30.4	89.4	4.8	5.2
	Exp.	"	195	424	39		78	441.5	103.2	273.3	41.9	53.6	155.0	8.3	5.4
	IV. Pre.	"	112	237	24		48	240.9	63.5	158 3	25 4	30.6	88.9	4.9	5.1
	Exp.	"	196	425	35		69	390.5	90.5	266.9	40.4	53.2	150.9	8.3	5.5
	V. Pre.	"	100	236	22		45	220.3	58.4	140.9	22.2	29.7	77.2	4.6	5.3
	Exp.	"	194	421	38		77	398.7	99.2	256.9	39.5	55.4	140.5	8.3	5.4
	VI. Pre.	"	103	237	22		43	218.9	56.7	141.5	21.9	30.2	77.6	4.6	5.4
	Exp.	"	185	426	42		85	392.9	110.7	260.1	41.4	54.6	142 3	8.5	5.2
SADIE	I. Pre.	No. 1	116	234	53	25	2	245.7	71.5	171.2	29.1	34.9	94.2	6.7	5.0
	Exp.	"	203	430	96	48	--	477.7	128.7	307.1	53.4	62.4	167.8	12.1	4.8
	II. Pre.	No. 4	109	230	41	7	14	233.9	54.3	153.3	23.8	34 4	83.8	4.6	5.4
	Exp.	"	201	530	48	--	48	397.0	84.9	247.4	34.3	61.5	127.7	7.0	6.0
	III. Pre.	No. 1	108	238	51	24	3	235.6	69.3	161.5	28.3	30.3	90.4	6.4	4.8
	Exp.	"	196	430	95	48	--	468.9	127.3	293.6	52.1	54.9	164.0	11.9	4.7
	IV. Pre.	No. 4	109	236	23	6	27	224.0	49.5	161.3	27.1	30.4	90.5	5.4	4.9
	Exp.	"	203	432	42	--	84	417.7	109.5	285.0	45.3	55.4	160.3	8.9	5.2
	V. Pre.	No. 1	107	240	53	24	2	239.4	70.2	153.5	26.4	31.6	83.8	6.4	4.9
	Exp.	"	198	421	95	48	--	430.0	127.0	277.8	48.0	57.4	151.2	11.7	4.9
	VI. Pre.	No. 4	105	237	25	2	42	224.2	60.2	145.1	22.9	30.7	79.3	4.9	5.3
	Exp.	"	190	432	41	--	82	395.6	107.3	261.7	41.0	55.5	143.3	8.6	5.3
EDITH	I. Pre.	No. 1	116	240	54	24	2	247.4	71.5	172.8	29.2	35 2	95.2	6.7	5.0
	Exp.	"	198	428	96	48		472.4	128.7	303.9	53.1	61.4	166.2	12.1	4.8
	II. Pre.	"	106	232	53	27		249.1	71.4	163.8	29.1	33.7	88.7	6.1	4.7
	Exp.	"	203	517	95	48		439.0	127.6	277.2	49.5	63.1	139.6	10 6	4.6
	III. Pre.	"	109	233	53	27		236.6	71.0	162.1	29.0	30.3	90.3	6.6	4.7
	Exp.	"	197	431	96	48		471.0	128.7	295.0	52.4	55.2	164.8	12.0	4.8
	IV. Pre.	"	109	226	53	27		242.1	71 0	160.3	28.2	30.1	89.5	6.5	4.9
	Exp.	"	199	419	96	48		428.8	128.0	292.8	51.2	55.1	163.8	11.9	4.8
	V. Pre.	"	108	222	53	27		235.5	71.0	151.3	26.5	31.0	82.1	6.4	4.6
	Exp.	"	201	393	95	47		422.4	126.1	272.4	47.4	56.5	147.6	11.5	4.8
	VI. Pre.	"	102	228	52	26		228.0	69 4	148.1	25.8	30.2	80.7	6.3	4.8
	Exp.	"	183	417	94	47		403.7	125.8	267.8	46.7	54.6	146.1	11.4	4.9

† Also 7 pounds dried brewers' grains.

Name of cow	Brewers' grains vs. cottonseed-linseed; malt sprouts vs. ground oats / Period numbers	Nature of ration (Nos. 1, 3, 4, 5)	Pounds eaten of: Hay	Silage	Wheat bran	½ cottonseed, ½ linseed	Malt sprouts	Dried brewers' grains	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental fodder	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
EUNICE	I. Pre.	No. 3	116	237	18	..	9	25	221.7	46.7	153.2	21.8	35.1	84.0	5.7	6.1
	Exp.	"	203	430	40	..	11	70	457.3	108.3	288.6	43.7	64.2	157.5	11.8	5.7
	II. Pre.	No. 1	114	239	49	22	..	9	258.7	71.4	169.4	29.2	35.8	91.4	6.4	4.9
	Exp.	"	209	548	96	48	..	..	453.0	128.4	285.9	50.4	65.5	144.1	10.8	4.6
	III. Pre.	No. 3	115	240	24	5	..	27	222.8	49 8	151.0	22.5	31.7	84.5	6.1	5.8
	Exp.	"	203	430	46	..	..	95	473.2	125.5	290.2	46.6	59.5	160.7	13.2	5.9
	IV. Pre.	No. 1	115	240	51	25	..	4	252.9	71.0	166.7	28.7	31.8	93.1	6.8	4.4
	Exp.	"	203	432	96	48	..	..	436.1	128.0	298.1	51.6	56.3	167.0	12.0	4.5
	V. Pre.	No 3	111	240	27	2	..	47	241.7	68 8	152.2	24.4	33.7	81.7	7.1	5.1
	Exp.	"	194	426	42	..	..	84	414.8	113.8	263.3	41.2	59.0	141.5	12.3	5.0
	VI. Pre.	No. 1	109	240	49	24	..	2	234.2	65.9	151.7	25.5	31.8	82.8	6.4	5.4
	Exp.	"	193	429	93	46	..	..	414.2	124.0	274.4	47.0	56.7	149.8	11.6	5.9
NAOMI	II. Pre.	No. 4	106	207	32	6	10		209.2	41.6	135.7	17.3	30.8	76.5	4.0	6.7
	Exp.	"	202	514	46	..	46		389.8	80.0	243.1	33.4	60.8	125.3	6.9	6.0
	III. Pre.	No. 5	112	239	52	25	3		239.9	69.8	162.9	21.4	30.1	98.0	6.0	6.6
	Exp.	"	199	429	96	48	..		469.8	126.0	291.4	37.7	53.7	176.1	10.8	6.8
	IV. Pre.	No. 4	119	229	20	6	20		221.3	40.5	144.9	19.5	30.3	82.9	4.6	6.3
	Exp.	"	201	427	24	..	49		368 5	63.5	252.1	34.8	53.0	142.4	7.7	6.1
	V. Pre.	No. 5	108	228	51	25	4		236.2	69.8	150.3	19.7	30.4	87.8	5.8	6.7
	Exp.	"	203	365	96	48	..		417.2	126.3	265.7	34.3	54.1	155.2	10.2	6.8
	VI. Pre.	No. 4	100	238	24	2	39		216.4	51.4	140.0	21.4	29.6	77.4	4.7	5.5
	Exp.	"	179	422	32	..	64		359.4	83.7	238.2	35.0	52.3	131.2	7.7	5.7
PRIMROSE	II. Pre.	No. 5	...	...	..	..	..		....	....	....	..	....	....	..	..
	Exp.	"	204	551	79	40	..		425.1	104.1	263.1	28.7	65.5	146.1	8.4	8.0
	III. Pre.	"	114	238	52	27	..		240.3	68.7	161.7	19.4	32.4	97.7	5.9	7.4
	Exp.	"	208	430	96	48	..		475.2	126.0	293.6	35.3	58.9	177.5	10.7	7.4
	IV. Pre.	"	114	240	53	27	..		248.7	69.8	162.7	19.8	32.6	97.9	5.9	7.3
	Exp.	"	203	431	96	48	..		431.2	125.7	291.3	35.5	58.2	175.6	10.7	7.3
	V. Pre.	"	109	240	52	27	..		239.9	68.8	152.6	19.4	31.5	89.5	5.6	6.9
	Exp.	"	201	432	96	48	..		436.2	127.2	278.2	35.3	57.5	162.9	10.1	6.9
	VI. Pre.	"	104	239	53	27	..		233.6	70.0	150.3	19.2	30.6	88.4	5.5	6.9
	Exp.	"	199	431	96	48	..		423.1	127.0	277.0	35.2	57.1	162.3	10.1	6.9
MINTA BELLA	I. Pre.	No. 4	...	...	..	..	..	..	....	....	....	..	....	....	..	..
	Exp.	"	187	414	40	..	75	7	428.2	99.7	278.0	42.8	58.3	154.1	8.7	5.4
	II. Pre.	No. 5	108	226	48	22	8	..	245.7	68.5	160.2	21.4	32.8	92.8	5.3	6.4
	Exp.	"	195	533	94	47	..	..	431.5	123.1	270.1	34.2	60.6	149.4	9.4	6.8
	III. Pre.	No. 4	110	237	25	1	44	..	229.3	61.6	157.0	24.1	30.2	88.6	4.8	5.4
	Exp.	"	196	428	38	..	77	..	442.2	101.4	273.5	41.7	53.8	155.3	8.3	5.5
	IV. Pre.	No. 5	113	238	51	24	4	..	247.6	69.0	162.6	21.6	30.3	97.1	5.9	6.5
	Exp.	"	197	429	93	46	..	..	423.4	121.3	287.5	37.4	53.4	172.9	10.6	6.7
ROSEL	II. Pre.	No. 5	98	237	54	26	..	..	242.4	70.2	157.4	18.7	33.1	94.3	5.3	7.4
	Exp.	No.	178	541	58	10	76	..	422.0	126.5	262.4	38.1	62.1	139.1	7.5	5.7
	III. Pre.	"	109	240	27	..	53	..	238.1	70.4	160.5	24.7	32.6	91.0	4.9	5.5
	Exp.	"	187	431	48	..	96	..	458.4	127.0	283.7	44.0	56.8	161.3	8.6	5.4
	IV. Pre.	"	109	240	26	..	53	..	244.3	69.7	160.2	25.1	32.5	92.2	5.0	5.3
	Exp.	"	173	426	28	..	55	..	350.0	72.1	240.6	32.5	51.9	138.4	7.4	6.4

Malt sprouts vs. ground oats; corn silage vs. apple pomace

Name of cow / Period numbers	Nature of ration	Pounds eaten of: Hay	Silage	Wheat bran	½ cottonseed, ½ linseed	Malt sprouts	Apple pomace	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental fodder	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
DOROTHY															
III. Pre.	No. 4	106	198	16	..	31		194.0	41.4	131.2	19.1	27.2	73.8	3.9	5.7
Exp.	"	193	360	28	..	57		386.3	75.0	238.1	34.7	49.4	134.1	7.1	5.8
IV. Pre.	No. 5	108	198	39	19	2		213.7	52.9	139.4	18.1	27.3	82.2	4.9	6.7
Exp.	"	195	357	68	34	..		367.7	89.0	247.9	31.4	49.1	146.5	8.7	6.9
V. Pre.	No. 4	87	195	17	2	27		178.0	40.1	113.5	16.4	24.9	62.7	3.7	5.9
Exp.	"	171	355	23	..	47		319.5	60.4	205.1	28.5	47.1	112.5	6.5	6.1
VI. Pre.	No. 5	81	200	35	17	1		179.7	48.2	115.9	14.6	24.0	67.9	4.4	7.0
Exp.	"	171	358	63	32	..		334.9	83.8	219.3	26.5	47.1	127.7	8.2	7.3
HALLOWE'N															
IV. Pre.	No. 5	...	...	..	..	..		....	....	....	....	....	....	..	..
Exp.	"	195	432	96	48	..		424.5	125.7	287.4	35.2	56.8	173.8	10 6	7.2
V. Pre.	"	103	240	53	27	..		235.5	69.7	150.0	19.1	30.4	88.3	5.5	6.9
Exp.	"	197	432	96	48	..		431.7	126.3	276.1	35.1	56.8	161.9	10.1	6.9
VI. Pre.	"	104	240	53	27	..		233.9	70.0	150.4	19.2	30.6	88.5	5.6	6.9
Exp.	"	197	432	96	48	..		421.6	127.0	276.1	35.1	56.8	161.9	10.1	6.9
ATALANTA															
II. Pre.	Silage	111	228	53	27	..	4	252.8	82.4	165.5	29.3	34.3	89.3	6.2	4.7
Exp.	"	202	526	96	48	..	....	441.3	134.7	278.7	49.8	63.3	140.4	10.6	4.6
III. Pre.	Pomace	111	93	53	27	..	146	226.6	57.6	....	....	....	....	....	..
Exp.	"	203	144	96	48	..	288	424 6	119.4	....	....	....	....	....	..
IV. Pre.	Silage	107	237	53	26	..	....	243.2	80.1	161.3	28.1	30.2	90.5	6.6	4.8
Exp.	"	185	432	96	48	..	....	420.4	129.2	288.6	50.5	53.4	162.5	11.8	4.8
V. Pre.	Pomace	109	91	52	26	..	148	224.7	59.7	....	....	....	....	....	..
Exp.	"	198	142	95	47	..	280	407.2	105.7	....	....	....	....	....	..
SURPRISE															
III. Pre.	Silage	...	...	..	..	..	....	....	....	....	....	....	....	..	..
Exp.	"	113	281	69	34	..	....	300.1	111.0	189.6	35.3	33.8	106.3	8.0	4.5
IV. Pre.	Pomace	71	44	39	20	..	116	154.4	41.2	....	....	..	....	..	..
Exp.	"	130	72	71	36	..	216	277.4	69.2	....	....	....	....	..	..
V. Pre.	Silage	71	160	40	20	..	....	165.8	50.2	106.7	19.2	21.3	58.1	4.6	4.7
Exp.	"	131	288	72	36	..	....	299.3	87.3	193.8	34.8	38.9	105.3	8.4	4.7
JERSEY LILY, 2nd															
I. Pre.	Pomace	65	79	39	18	2	100	156.3	44.3	....	....	....	....	....	..
Exp.	"	118	113	72	36	..	171	280.6	78.6	....	....	....	....	....	..
II. Pre.	"	74	68	40	20	..	101	164.0	44.4	....	....	....	....	....	..
Exp.	"	137	212	72	36	..	198	312.4	95.3	....	....	....	....	....	..
III. Pre.	"	77	66	39	20	..	97	159.9	39.6	....	....	....	....	....	..
Exp.	"	132	117	71	36	..	181	296.3	85.5	....	....	....	....	....	..
IV. Pre.	"	77	72	40	20	..	90	164.8	44.7	....	....	....	....	....	..
Exp.	"	140	143	72	36	..	168	299.4	79.9	....	....	....	....	....	..
V. Pre.	"	78	69	39	19	..	77	157.9	37.9	....	....	....	....	....	..
Exp.	"	137	134	70	35	..	96	276.7	62.1	....	....	....	....	....	..
LAVENDER															
II. Pre.	Silage	103	239	53	27	..	....	248.9	85.6	162.9	27.2	35.1	89.7	6.0	5.1
Exp.	"	200	545	95	48	..	....	443.5	139.5	277.9	46.0	66.8	142.5	10.3	5.1
III. Pre.	Pomace	117	94	53	27	..	146	232.2	57.9	....	....	....	....	....	..
Exp.	"	206	144	96	48	..	288	425.2	119.4	....	....	....	....	....	..
IV. Pre.	Silage	116	240	53	27	..	....	251.6	81.1	165.9	27.3	33.9	93.0	6.6	5.2
Exp.	"	199	432	96	48	..	....	430.3	129.2	293.4	48.6	59.3	165.0	11.8	5.2
V. Pre.	Pomace	108	92	53	27	..	148	226.7	60.0	....	....	....	....	....	..
Exp.	"	201	144	96	48	..	288	414.1	108.1	....	....	....	....	....	..
VI. Pre.	Silage	109	239	53	27	..	....	239.2	70.7	155.2	26.8	32.4	84.3	6.2	4.9
Exp.	"	200	432	95	48	..	..	424.9	117.5	281.0	48.3	59.0	152.6	11.2	4.9

Name of cow	Corn silage vs. apple pomace / Period numbers	Nature of ration	Pounds eaten of: Hay	Silage	Wheat bran	½cottonseed, ½linseed	Corn meal	Apple pomace	Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental fodder	Pounds of digestible nutrients eaten during period: Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	Nutritive ratio, 1 :
SYLVIA	I. Pre.	Silage	148	240	53	25	2	....	276.5	70.3	188.4	28.4	43.0	104.2	6.8	5.7
	Exp.	"	264	431	96	48		....	532.6	168.1	337.3	52.4	77.0	184.9	12.3	5.5
	II. Pre.	Pomace	142	104	53	27		132	261.6	63.5	....	....	....	....	....	..
	Exp.	"	265	263	95	48		288	488.2	126.9	....	....	....	....	....	..
	III. Pre.	Silage	152	240	53	27		....	276.7	71.5	184.9	29.7	40.3	101.4	7.0	5.3
	Exp.	"	273	432	96	48		....	534.1	170.6	331.8	53.4	72.4	182.4	12.5	5.3
	IV. Pre.	Pomace	153	104	53	27		132	267.5	65.2	....	....	....	....	....	..
	Exp.	"	261	144	96	48		273	458.5	103.4	....	....	-	....	....	..
MONA	I. Pre.	Pomace	187	94	54	24	2	145	299.9	58.2	....	....	....	....	....	..
	Exp.	"	329	144	96	48		288	536.9	114.4	....	....	....	....	....	..
	II. Pre	"	190	98	53	27		140	303.9	63.0	....	....	....	....	....	..
	Exp.	"	341	258	96	48		288	554.8	125.6	....	....	....	....	....	..
	III. Pre.	"	149	80	53	27		160	259.2	56.6	....	....	....	....	....	..
	Exp.	"	265	143	96	48		284	478.4	118.1	....	....	....	....	....	..
	IV. Pre.	"	151	76	53	27		135	263.5	56.3	....	....	....	....	....	..
	Exp.	"	276	140	96	48		245	467.4	96.0	....	....	....	....	....	..
	V. Pre.	"	133	72	53	27		112	233.9	46.1	....	....	....	....	....	..
	Exp.	"	277	144	96	48		160	452.4	79.1	....	....	....	....	....	..
PHYLLIS	I. Pre.	Silage	119	240	53	25	2	....	250.1	70.3	174.4	29.4	35.7	96.0	6.8	5.0
	Exp.	"	203	428	96	48		....	476.9	166.9	306.6	53.4	62.3	167.4	12.1	4.8
	II. Pre.	Pomace	116	107	53	27		132	239.5	64.5	....	....	....	....	....	..
	Exp.	"	210	257	95	47		288	437.3	125.4	....	....	....	....	....	..
	III. Pre.	Silage	117	240	53	27		....	245.8	71.5	168.1	29.6	31.9	93.5	6.7	4.8
	Exp.	"	203	424	96	48		....	473.5	167.5	296.4	52.7	55.8	165.1	12.0	4.7
	IV. Pre.	Pomace	118	80	53	27		143	233.0	59.5	....	....	....	....	....	..
	Exp.	"	213	144	96	48		256	415.6	99.7	....	....	....	....	....	..
	V. Pre.	Silage	110	240	53	27		....	243.0	75.4	155.9	26.9	32.2	85.0	6.6	4.9
	Exp.	"	205	420	96	48		....	436.8	127.3	282.0	48.6	58.6	153.2	11.8	4.9
SONOMA	I. Pre.	Pomace	112	91	40	18	2	144	212.8	57.2	....	....	....	....	....	..
	Exp.	"	186	142	72	36		287	376.1	113.4	....	....	....	....	....	..
	II. Pre.	Silage	101	212	39	20		16	221.9	79.1	143.5	23.7	31.0	78.0	5.1	5.1
	Exp.	"	201	539	70	35		....	409.0	138.0	257.0	41.2	62.3	129.7	9.1	5.2
	III. Pre.	Pomace	115	94	40	20		146	212.6	57.9	....	....	....	....	....	..
	Exp.	"	205	144	71	36		285	393.1	118.3	....	....	....	....	....	..
	IV. Pre.	Silage	119	240	40	20		....	237.7	81.1	157.1	24.8	31.6	88.3	5.9	5.4
	Exp.	"	205	431	72	36		....	405.7	128.9	277.7	44.1	55.3	156.4	10.6	5.3
	V. Pre.	Pomace	112	92	40	20		132	208.2	56.6	....	....	....	....	....	..
	Exp.	"	209	144	72	36		273	385.9	104.8	....	....	....	....	....	..
	VI Pre.	Silage	105	239	39	19		....	216.1	70.7	140.1	21.9	30.5	76.9	5.6	5.5
	Exp.	"	191	431	71	35		....	383.6	117.2	254.2	39.8	55.3	139.5	10.2	5.5

Name of cow	King glutens, high and low in protein / Period numbers	Nature of ration (Nos. 6 and 7)	Pounds eaten of						Pounds eaten of total dry matter in entire ration	Pounds eaten of total dry matter in experimental feed	Pounds of digestible nutrients eaten during period					Nutritive ratio, 1:
			Hay	Silage	Wheat bran	King gluten meal (low)	King gluten me'l (high)	½ cottonseed ½ linseed			Dry matter	Protein	Crude fiber	Nitrogen-free extract	Ether extract	
CRYS'L GIRL	IV. Pre.	No. 1	---	---	--	--	--	36	367.7	96.0	251.3	41.7	49.7	140.0	9.7	5.1
	Exp.	"	190	356	72	--	--	19	209.6	51.5	133.8	21.5	29.5	72.3	5.3	5.3
	V. Pre.	"	111	193	39	--	--	36	378.5	95.9	242.9	39.5	53.3	131.1	9.7	5.2
	Exp.	"	202	342	72	--	--	20	207.0	52.5	133.4	21.6	29.1	72.4	5.4	5.3
	VI. Pre.	"	107	199	39	--	--	36	370.9	96.2	243.8	39.5	53.2	132.1	9.8	5.3
	Exp.	"	197	359	72	--	--									
BEAUTINA	IV. Pre.	No. 6	106	238	53	25	2	--	243.7	71.2	163.5	25.9	28.7	96.2	6.0	5.4
	Exp.	"	197	430	95	48	--	--	428.7	126.3	297.0	46.6	52.7	174.6	10.9	5.4
	V. Pre.	No. 7	103	236	53	2	25	--	235.7	71.2	154.2	26.3	29.3	88.1	5.4	4.9
	Exp.	"	201	432	96	--	48	--	436.7	127.7	287.4	48.5	55.7	163.4	10.0	5.0
	VI. Pre.	No. 6	97	240	53	25	2	--	228.2	70.6	151.6	24.2	28.4	88.0	5.7	5.3
	Exp.	"	196	432	96	48	--	--	420.5	127.2	284.2	44.4	54.8	164.3	10.5	5.5
MAX ELLA	III. Pre.	No. 6	110	240	53	25	--	2	238.3	69.7	165 9	26.3	29.5	97.1	6.1	5.4
	Exp.	"	195	429	96	48	--	--	456.4	126.1	296.4	46.6	52.3	174.2	10.9	5.4
	IV. Pre.	No. 7	112	240	52	2	25	--	249.4	70.9	168.0	27.8	29.8	98.0	5.7	5.1
	Exp.	"	199	431	96	--	48	--	432.6	128.2	300.9	50.1	53.2	175.5	0.1	5 0
	V. Pre.	No. 6	101	239	53	25	2	--	234.4	70.7	153.6	24.4	29.1	89.(	5.7	5.4
	Exp.	"	199	429	96	48	--	--	433.5	127.2	285.2	44.5	55.2	164.(	0.6	5.5
	VI. Pre.	No. 7	100	240	53	2	25	--	230.4	70 1	153.3	26.2	29.0	87.8	5.4	4.9
	Exp.	"	194	432	96	--	48	--	420.1	128.2	283.7	48.2	54.5	161.(	9.9	5.0
HAIDEE	III. Pre.	No. 6	---	---	--	--	--	--	---	---	---	---	---	---	---	---
	Exp.	"	195	428	96	48	--	--	466 0	126.1	296.1	46.6	52.3	174.1	10.9	5.4
	IV. Pre.	No. 7	118	240	53	2	25	--	254.5	70.9	171.2	28.2	30.8	99.4	5.7	5.1
	Exp.	"	206	432	96	--	48	--	439.0	128.2	304.8	50.5	54.4	177.4	10.2	5.0
	V. Pre.	No. 6	106	236	53	25	2	--	237.6	72.5	155.6	24.6	29.8	89.9	5.8	5.4
	Exp.	"	206	432	96	48	--	--	440.6	127.2	289 5	44.9	56.5	166.9	10.7	5.5
	VI. Pre.	No. 7	112	240	53	2	25	--	242.2	71.2	159.9	26.8	31.0	91.0	5.6	5.0
	Exp.	"	194	432	96	--	48	--	420.1	128.2	283.7	48.2	54.5	161.6	9 9	5.0
STAR BRIGHT	III. Pre.	No. 7	114	240	53	--	25	2	243 0	70.8	169.0	28.1	30.2	98.0	5.7	5.0
	Exp.	"	202	426	96	--	48	--	472 0	126.7	301.2	50.2	53.5	175.4	10.1	5.0
	IV. Pre.	No. 6	115	240	53	25	2	--	251.1	70.1	168.7	26 5	30.2	98.8	6.1	5.4
	Exp.	"	200	431	96	48	--	--	432.5	127.2	299.5	47.0	53.2	175.9	11.0	5.4
	V. Pre.	No. 7	108	239	53	2	25	--	241.0	71.2	157.6	26 6	30.3	89.8	5.5	5.0
	Exp.	"	202	431	96	--	48	--	137.3	127.7	287.8	48.6	55.8	163.5	10.0	5.0
	VI. Pre.	No. 6	106	238	53	25	2	--	235.7	70.6	155.8	24.6	29.9	90.1	5 8	5.4
	Exp.	"	193	432	95	47	--	--	417.1	126.1	281.3	44.2	54.3	163.5	10.5	5.5

V. RECORD SHOWING PRODUCTION AND SAME PER UNIT FOR EACH INDIVIDUAL COW IN FEEDING TESTS

Name of cow	Low, medium and high feeding / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten: In entire ration — Milk	Total solids	Fat	In experimental feed — Milk	Total solids	Fat
		No. 2	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
GOLDENROD	I. Pre.	Medium	273.5	71.2	132.3	17.68	7.32	23.39	9.68	48.4	8.6	3.54	----	---	---
	Exp.	"	515.9	128.6	253.5	17.12	6.96	43.40	17.64	49.1	8.4	3.42	----	---	---
	II. Pre.	Low	251.1	39.0	137.0	17.07	6.88	23.38	9.42	54.6	9.3	3 75	----	---	---
	Exp.	"	429.6	63.3	206.8	17.85	7.50	36.91	15.51	48.1	8.6	3.61	----	---	---
	III. Pre.	Medium	268.6	68.5	122.3	17.74	7.45	21.70	9.11	45.5	8.1	3.39	----	---	---
	Exp.	"	520.5	126.3	214.6	17.80	7.60	38.20	16.31	41.2	7.3	3.13	----	---	---
	IV. Pre.	Low	249.9	35.8	108.6	17.78	7.50	19.31	8.15	43.5	7.7	3.26	----	---	---
	Exp.	"	420.7	63.4	189.9	17.30	7.16	32.85	13.59	45.2	7.8	3.24	----	---	---
	V. Pre.	Medium	246.8	69.4	113.1	17.10	7.04	19.34	7.96	45.8	7.8	3.23	----	---	---
	Exp.	"	484.6	125.4	214.4	16.87	6.85	36.17	14.68	44.2	7.5	3.03	----	---	---
	VI. Pre.	Low	216.6	35.8	98.1	16.73	6.82	16.41	6.69	45.3	7.6	3.09	----	---	---
	Exp.	"	387.9	64.1	154.8	16.72	6.85	25.88	10.61	39.9	6.7	2.74	----	---	---
BUTTERCUP	I. Pre.	Low	286.0	35.5	159.1	17.69	6.79	28.14	10.81	55.6	9.8	3.78	448.2	79.3	30.5
	Exp.	"	543.6	62.5	296.4	17.42	6.79	51.64	20.13	54.5	9.5	3.70	474.3	82.6	32.2
	II. Pre.	"	296.2	35.5	162.0	17.78	6.90	28.81	11.18	54.7	9.7	3.77	456.4	81.1	31.5
	Exp.	"	512.2	64.2	284.5	17.22	6.66	48.99	18.94	55.5	9.6	3.70	443.3	76.3	29.5
	III. Pre.	"	281.1	35.6	164.3	16 93	6.57	27.81	10.80	58.4	9.9	3.84	461.6	78.1	30.3
	Exp.	"	543.4	63.6	265.6	16.91	6.68	44.93	17.74	48.9	8.3	3.26	417.6	70.6	27.9
	IV. Pre.	"	290.7	35.8	129.3	17.52	6.90	22.65	8.92	44.5	7.8	3.07	361.2	63.3	24.9
	Exp.	"	508.4	64.2	238.3	16.98	6.63	40.45	15.79	46.9	8.0	3.11	370.6	62.9	24.6
	V. Pre.	"	279.6	35.6	134.2	16.45	6.32	22.08	8.48	48.0	7.9	3.03	377.0	62.0	23.8
	Exp.	"	507.3	63.6	240.6	16.69	6.40	40.16	15.40	47.4	7.9	3.04	378.3	63.1	24.2
	VI. Pre.	"	275 6	35.8	129.6	16.64	6.37	21.57	8.26	47.0	7.8	3.00	362.0	60.3	23.1
	Exp.	"	496.8	64.2	228.5	16.29	6.14	37.22	14.02	46.0	7.5	2.82	356.0	58.0	21.8
L. DOONE	IV. Pre.	Medium	164.9	51.1	186.5	13.17	3.68	24.56	6.86	113.1	14.9	4.16	----	---	---
	Exp.	"	280.2	93.8	335.9	13.37	4 02	44.91	13.50	119.9	16.0	4.82	----	---	---
	V. Pre.	Low	141.0	26.7	158.7	13.11	3.93	20.81	6.24	112.5	14.8	4.43	----	---	---
	Exp.	"	253.7	47.7	278.1	12.71	3.63	35.34	10.09	109.5	13.9	3.98	----	---	---
	VI. Pre.	Medium	157.0	49.2	159 2	13.01	3.80	20.71	6.05	101.4	13.2	3.85	----	---	---
	Exp.	"	285.9	94.5	294.2	12.77	3.67	37.58	10.81	102.9	13.1	3.78	----	---	---
KIMBERLEY	IV. Pre.	Low	199.8	34.0	216.5	12.72	3.80	27.55	8.23	108.4	13.8	4.12	636.8	81.0	24.2
	Exp.	"	338.9	64.3	394.4	12.69	3.68	50.03	14.50	116.4	14.8	4.28	613.2	77.9	22.6
	V. Pre.	"	187.2	30.3	207.5	12.72	3.77	26.40	7.83	110.8	14.1	4.18	684.8	87.1	25.8
	Exp.	"	337.2	55.6	392.9	12.62	3.64	49.57	14.29	116.5	14.7	4.24	706.6	89.2	25.7
	VI. Pre.	"	190.5	34.9	217.8	12.58	3.70	27.40	8.05	114.3	14.4	4.23	624.0	78.5	23.1
	Exp.	"	339.1	61.4	377.1	12.70	3.70	47.88	13.95	111.3	14.1	4.11	614.1	78.0	22.7
VIOLA	II. Pre.	Medium	250.2	70.8	115.8	16.06	5.84	34.66	12.61	86.3	13.9	5.04	----	---	---
	Exp.	"	447.7	127.6	387.6	15.60	5.76	60.45	22.32	86.6	13.5	4.99	----	---	---
	III. Pre.	Low	208.3	35.6	198 8	14.89	5.20	29.61	10.33	95.4	14.2	4.96	----	---	---
	Exp.	"	418.2	63.6	321.6	14.50	5.03	46.63	16.16	76.9	11.2	3.86	----	---	---
	IV. Pre.	Medium	250.9	69.0	175.4	14.19	4.73	24.89	8.29	69.9	9.9	3.30	----	---	---
	Exp.	"	436.0	128.6	299.0	14.10	4.84	42.17	14.46	68.6	9.7	3.32	----	---	---
	V. Pre.	Low	206.7	35.6	147.9	14.00	4.79	20.70	7 09	71.6	10.0	3.43	----	---	---
	Exp.	"	377.0	63.6	249.5	13.77	4.60	34.35	11.48	66.2	9.1	3.05	----	---	---
	VI. Pre.	Medium	227.7	68.0	135.9	13.53	4.53	18.39	6.15	59 7	8.1	2.70	----	---	---
	Exp.	"	417.6	125.7	237.6	13.50	4.53	32.08	10.77	56.9	7.7	2.58	----	---	---

* In total ration. † In experimental portion of ration.

Name of cow	Low, medium and high feeding / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten. In entire ration: Total solids	In entire ration: Fat	In entire ration: Milk	In experimental feed: Total solids	In experimental feed: Fat	In experimental feed: Milk
		No. 2	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs
STELLA	II. Pre.	Medium											
	Exp.	"	432.9	124.9	318.1	14.30	4.60	74 09	23.83	119.7	17.1	5.51	414.9	59.3	19.1
	III. Pre.		242.5	71.2	187.8	14.22	4.62	40.93	13.30	118.6	16.9	5.48	404.2	57.5	18.7
	Exp.		463.5	125 4	518.1	13.84	4.37	71.72	22.63	111.8	15.5	4.88	413.3	57.2	18.0
	IV. Pre.		247.7	71.7	285.0	13.86	4 40	39.49	12.53	115.1	15.9	5.06	397.5	55.1	17.5
	Exp.		436.2	128.6	484.3	13.77	4.39	66.68	21.25	111.0	15.3	4.87	376.6	51.9	16.5
	V. Pre.		241.6	71.2	276.0	13.71	4.30	37.84	11.87	114.2	15.7	4.91	387.6	53.1	16.7
	Exp.		441.2	127.2	496.6	13.83	4.39	68.69	21.78	112.6	15.6	4.94	390.4	54.0	17.1
	VI. Pre.		243.2	71.6	269.7	13.76	4.41	37.19	11 88	110.9	15.3	4.89	376.7	51.8	16.6
	Exp.		429.9	127.5	479.3	13.89	4.51	66.59	21.63	111.5	15.5	5.03	375.9	52.2	17.0
ADELAIDE	I. Pre.	Medium	249.8	71.2	160 2	15.47	5.80	24.79	9.29	64.1	9.9	3.72	----	---	---
	Exp.	"	467.8	121.4	308.6	14.89	5.33	45.96	16.45	66.0	9.8	3.52	----	---	---
	II. Pre.	High	266.5	83.4	162.8	14.35	5.10	23.36	8.31	61.1	8.8	3.12	----	---	---
	Exp.	"	486.5	175.7	295.4	14.37	5.12	42.44	15.13	60.7	8.7	3.11	----	---	---
	III. Pre.	Medium	238.0	65.0	155.0	14.94	5.54	23.15	8.58	65.1	9.7	3.61	----	---	---
	Exp.	"	462.7	127.2	281.8	14.58	5.28	41.07	14.89	60.9	8.9	3.22	----	---	---
	IV. Pre.	High	266.9	91.4	155.3	14.40	5.20	22.36	8.07	58.2	8.4	3.02	----	---	---
	Exp.	"	437.7	147.3	279.3	14.60	5.29	40.77	14.77	63.8	9.3	3.37	----	---	---
	V. Pre.	Medium	214.0	53.4	146.4	14.23	5.05	20.83	7.39	68.4	9.7	3.45	----	---	---
	Exp.	"	381.8	90.9	268.0	14.38	5.15	38.54	13.80	70.2	10.1	3.61	----	---	---
	VI. Pre.	High	231.7	72.5	146.2	14.34	5.20	20.97	7.61	63.1	9.1	3.28	----	---	---
	Exp.	"	421.3	152.4	270.1	14.46	5.24	39.66	14.15	64.1	9.3	3.36	----	---	---
CLARE	I. Pre.	Medium	246.2	71.2	249.7	14.21	4.80	35.47	11.98	101.4	14.4	4.87	350.7	49.8	16.8
	Exp.	"	471.4	126.8	465.1	14.01	4.73	65.14	22.02	98.7	13.8	4.67	366.8	51.4	17.4
	II. Pre.		252.0	71.0	267.2	14.20	4.80	37.94	12.82	106.0	15.1	5.09	376.3	53.4	18.1
	Exp.		444.7	127.6	457.5	14.29	4.84	65.37	22.13	102.9	14.7	4.98	358.6	51.2	17.3
	III. Pre.		243.3	70.3	248.7	14.33	5.00	35.64	12.43	102.2	14.6	5.11	353.8	50.7	17.7
	Exp.		473.9	127.2	407.9	14.13	4.85	57.64	19.78	86.1	12.2	4.17	320.7	45.3	15.6
	IV. Pre.		251.0	78.7	224.1	14.10	4.85	31.59	10.87	89.3	12.6	4.33	312.6	44.1	15.2
	Exp.		435.7	128.6	402.1	13.87	4.60	55.76	18.48	92.3	12.8	4.24	312.7	43.4	14.4
	V. Pre.		239.7	71.2	211.1	14.01	4.78	29.57	10.09	88.1	12.3	4.21	296.5	41.5	14.2
	Exp.		435.3	127.2	399.8	13.80	4.55	55.19	18.21	91.9	12.7	4.18	314.3	43.4	14.3
	VI. Pre.		236.4	71.6	208.8	13.85	4.65	28.93	9.71	88.3	12.2	4.11	291.6	40.4	13.6
	Exp.		403.6	125.6	363.1	13.73	4.62	49.85	16.79	90.0	12.4	4.16	289.1	39.7	13.4
MAX BELLE	I. Pre.	High	254.9	84.5	172.7	16.12	5.87	27.84	10.14	67.8	10.9	3.98	----	---	---
	Exp.	"	530.1	187.5	321.5	15.94	5.86	51.24	18.85	60.7	9.7	3.56	----	---	---
	II. Pre.	Medium	255.7	72.7	181.9	15.97	5.80	29.05	10.55	71.1	11.4	4.13	----	---	---
	Exp	"	445.1	124.9	317.9	16.20	5.98	51.49	19.01	71.4	11.6	4.27	----	---	---
	III. Pre.	High	273.4	101.5	173.5	16.26	6.02	28.21	10.45	63.5	10.3	3.82	----	---	---
	Exp.	"	514 3	180.1	268.4	16.40	6.21	44.02	16.66	52.1	8.6	3.24	----	---	---
	IV. Pre.	Medium	251.0	71.7	148.8	16.10	6.01	23.96	8 94	59.3	9.6	3.56	----	---	---
	Exp.	"	436.8	127.7	270.5	15.86	5.82	42.89	15.75	61.9	9.8	3.61	----	---	---
	V. Pre.	High	271 3	102.4	151.1	15 50	5.57	23.42	8.42	55.7	8.6	3.10	----	---	---
	Exp	"	476.0	180.1	275.6	15.52	5.58	42.77	15.37	57.9	9.0	3.23	---	---	---
	VI. Pre.	Medium	233.6	68.9	147.6	15.32	5.62	22.61	8.30	63.2	9.7	3 55	----	---	---
	Exp.	"	416.8	127.5	264.7	15.14	5.49	40.09	14.54	63.5	9.6	3.49	----	---	---

*** In total ration. † In experimental portion of ration.**

Name of cow	Low, medium and high feeding / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten. In entire ration: Milk	Total solids	Fat	In experimental feed: Milk	Total solids	Fat
		No. 2	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
LUCERNE	I. Pre.	High	244.2	81.8	236.7	15.46	5.35	36.59	12.67	96.9	15.0	5.19	289.4	44.7	15.5
	Exp.	"	480 6	154.5	439.6	15.28	5.39	67.16	23.67	91.5	14.0	4.92	284.5	43 5	15.3
	II. Pre.	"	269.7	90.5	250.5	15.47	5.55	38.74	13.91	92.9	14.4	5.16	276.8	42.8	15.4
	Exp.	"	483.4	177.6	433.7	15.52	5.58	67 32	24.19	89.7	13.9	5.00	245.6	38.1	13.7
	III. Pre.	"	271.6	99.7	235.4	15.67	5.77	36.89	13.57	86.7	13.6	5.00	236.1	37.0	13.6
	Exp.	"	508.8	172.2	402.6	16 08	6.13	64.71	24.66	79.1	12.7	4.85	233.8	37.6	14.3
	IV. Pre.	"	278.5	100.4	227.5	15.9	6.00	36.21	13.64	81.7	13.0	4.90	226.6	36.1	13.6
	Exp.	"	475.8	172.3	393.0	15.86	5.96	62.33	23.43	82.6	13.1	4 92	228.1	36.2	13.6
	V. Pre.	"	259.2	93.3	210.9	15.47	5.80	32.63	12.24	81.4	12.6	4.72	226.0	35.0	13.1
	Exp.	"	454 9	158.9	376 4	15.69	5.86	59.04	22.06	82.7	13.0	4.85	236.9	37.2	13.9
	VI. Pre.	"	243.3	85.0	202.6	15.47	5.68	31.34	11.50	83.3	12.9	4.73	238.4	36.9	13.5
	Exp.	"	427.6	149.8	359.5	15.66	5.93	56.28	21.32	84.1	13.2	4 99	240.0	37.6	14.2
SERENA	II. Pre.	Medium	244.2	59.5	281.6	14.14	4.58	39.83	12 88	115.3	16.3	5.27	----	---	---
	Exp.	"	444.7	120.4	466.1	13.94	4.52	64.99	21.07	104.8	14.6	4.74	----	---	---
	III. Pre.	High	259.3	89 8	245.6	13.80	4.23	33.88	10.38	94.7	13.1	4.00	----	---	---
	Exp.	"	501.5	164.7	114.1	13.85	4.41	57.35	18.27	82.6	11.4	3.64	----	---	---
	IV. Pre.	Medium	250.9	69.0	05.6	13.80	4.37	28.37	8.99	81.9	11.3	3.58	----	---	---
	Exp.	"	430.2	115.2	367.9	13.79	4.33	50.74	15.93	85.5	11.8	3.70	----	---	---
	V. Pre.	High	259.9	104.0	190.7	13.93	4.49	26.56	8.57	73.4	10.2	3.30	----	---	---
	Exp.	"	435.8	140.4	335.2	13.84	4.48	46.40	15.01	76.9	10.6	3.44	----	---	---
	VI. Pre.	Medium	231.0	66.2	177.2	13.84	4.55	24.52	8.06	76.7	10 6	3.49	----	---	---
	Exp.	"	393 5	105.2	301.7	13.54	4.30	40.84	12.98	76.7	10.4	3.30	----	--	---
ROSEMARY	II. Pre.	High	254.0	86.1	304.4	14.25	4.35	43.38	13.23	111.9	17.1	5.21	353.5	50.4	15.4
	Exp.	"	478.3	179.3	539.7	13.99	4.46	75.49	24.08	112.8	15.8	5.03	301 0	42.1	13.4
	III. Pre.	"	273.3	103 2	286.6	13.72	4.32	39.33	12 39	104.9	14.4	4.53	277.4	38.1	12.0
	Exp.	"	523.4	182.8	514.4	13.78	4.44	70.86	22.81	98.3	13.5	4.36	281.4	38.8	12.5
	IV. Pre.	"	281.1	104.8	271.0	13.85	4 45	37.57	12.05	96 4	13.4	4.29	258.6	35.9	11.5
	Exp.	"	469.4	172.3	472.1	13.99	4.53	66.04	21.39	100.6	14.1	4.56	274.0	38.3	12.4
	V. Pre.	"	271.3	98.8	254.5	13.80	4.45	35.11	11.33	93.8	12.9	4 18	257.6	35.5	11.5
	Exp.	"	473.5	169.5	432.6	13.81	4.46	59.74	19.31	91.3	12.6	4.08	255.2	35.2	11.4
	VI Pre.	"	261.7	94.9	227.0	13.78	4.50	31.28	10.21	86.7	12.0	3.90	239.2	33.0	10.8
	Exp.	"	454.5	164.9	406.9	13.95	4 64	56.76	18.89	89.5	12.5	4.16	246.8	34.4	11.5

* In total ration. † In experimental portion of ration.

Name of cow	Low, medium and high feeding / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten. In entire ration: Milk	Total solids	Fat	In experimental feed: Milk	Total solids	Fat
		No. 2	lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
FRESNO	I. Pre.	Medium	244.3	71.8	250.5	13.78	4.15	34.51	10.38	102.5	14.1	4.25	----	----	---
	Exp.	"	467.6	128.4	465.1	13.57	4.11	63.10	19.14	99.5	13.5	4.09	----	----	---
	II. Pre. ‡	Low	208.3	31.3	224.0	14.18	4.66	31.66	10.43	107.5	15.2	5.01	----	----	---
	Exp. ‡	"	382.8	61.3	346.8	13.93	4.47	48.30	15.51	90 6	12.6	4.05	----	----	---
	III. Pre.	Medium	235.8	68.1	202.8	13.70	4.35	27.79	8.82	86.0	11.8	3.74	----	----	---
	Exp.	"	476.6	128.2	397.3	13.63	4.24	54.15	16 86	83.4	11.4	3.54	----	----	---
	IV. Pre.	Low	213.8	36.2	200.6	13.59	4.25	27.26	8.53	93 8	12.8	3.99	----	----	---
	Exp.	"	374.7	64.8	327.9	13.63	4.27	44.68	13.99	87.5	11.9	3.73	----	----	---
	V. Pre.	Medium	237.5	70.6	179.1	13.67	4.25	24.49	7.61	75.4	10.3	3.20	----	----	---
	Exp.	"	431.3	129.1	319.8	13.66	4.36	43.68	13.94	74.2	10.1	3.23	----	----	---
	VI. Pre.	Low	202.4	36.1	175.3	13.65	4.25	23 93	7.45	86.6	11.8	3.68	----	----	---
	Exp.	"	356.8	64.9	313.3	13.40	4.16	41.98	13.04	87.8	11.8	3.66	----	----	---
SANTA ROSA	I. Pre.	Low	201.5	35.9	162.3	14.16	4 62	22.99	7.50	80 5	11.4	3.72	452.1	64.0	20.9
	Exp.	"	391.2	63.7	290.1	14.31	4.71	41.51	13.66	74.2	10.6	3.49	455.4	65.2	21.4
	II. Pre.	"	210.9	35.7	164.3	14.30	4.58	23.49	7.52	77.9	11.1	3.57	460.2	65.8	21.1
	Exp.	"	373.9	62.2	276.8	14.25	4.67	39.45	12.93	74.0	10.6	3.46	445.0	63.4	20.8
	III. Pre.	"	205.8	33.6	154.3	14.60	4.82	22.52	7.44	75.0	10.9	3.62	459.3	67.0	22.1
	Exp.	"	414.3	63.2	271.9	14.44	4.81	39.27	13.09	65.6	9.5	3.16	430.2	62.1	20.7
	IV. Pre.	"	219.0	36.2	145.4	14.67	4.90	21.26	7.13	66.4	9.7	3.26	401.7	58.7	19.7
	Exp.	"	375.7	64.8	251.9	14.71	4.88	37.05	12.30	67.1	9.9	3.27	388.7	57.2	19.0
	V. Pre.	"	208.2	36.2	131.7	14.78	5.03	19.46	6.62	63.3	9.4	3.18	363.8	53.8	18.3
	Exp.	"	375.7	65.0	234.1	14.85	5.16	34.76	12.07	62.3	9.3	3.21	360.2	53 5	18.6
EVA	II. Pre.	Low	206.7	26.8	230.8	15.99	5.89	36.90	13.60	111.7	17.9	6.58	----	----	---
	Exp.	"	369.7	52.5	455.5	14.97	5.37	68.16	24 48	123.2	18.4	6.62	----	----	---
	III. Pre.	Medium	235.8	65.4	262.0	14.90	5.45	39.03	14.28	111.1	16.6	6.06	----	----	---
	Exp.	"	480.1	128.2	469.4	15.35	5.61	72.08	26.34	97.8	15.0	5.49	----	----	---
	IV. Pre.	Low	211.2	36.2	219.4	15.35	5.61	33.69	12.30	103.9	16.0	5.82	----	----	---
	Exp.	"	378.2	64.8	359.4	15.07	5.39	54.17	19.36	95.0	14.3	5.12	----	----	---
	V. Pre.	Medium	240.8	69.7	199.1	15.21	5.60	30.29	11.15	82.7	12.6	4.63	----	----	---
	Exp.	"	441.3	130.0	412.1	15.35	5.64	63.27	23.26	93.4	14.3	5.27	----	----	---
	VI. Pre.	Low	204.4	36.1	212.4	15.29	5.56	32.47	11.81	103.9	15.9	5.78	----	----	---
	Exp.	"	359.5	63.1	371.5	15.10	5.55	56.08	20.61	103 3	15.6	5.73	----	----	---
MERMAID	IV. Pre.	Low	213.4	36.2	301.5	14.17	4.73	42.74	14.25	141.3	20.0	6.68	832 9	118.1	39.4
	Exp.	"	375.8	64.8	513.4	13.91	4.57	71.42	23.47	136.7	19.0	6.25	792.3	110.1	36.2
	V. Pre.	"	211.7	36.2	265 8	13.88	4.65	36.90	12.36	125.6	17.4	5.84	734.2	101.9	34.1
	Exp.	"	383.7	65.0	469.9	14.17	4.75	66.58	22.31	122.5	17.3	5.81	723.0	102.4	34.3
	VI. Pre.	"	209.8	36.1	258.8	14.16	4.81	36.66	12.44	123.4	17.5	5.93	717.0	101.6	34.5
	Exp.	"	367.6	64.9	444.5	14.25	4.92	63.33	21.87	120.9	17.2	5 95	685.0	97.6	33.7
SANTA CLARA	I. Pre.	Medium	191.7	37.8	105.7	16.78	6.62	17.74	7.00	55.1	9.3	3.65	279.6	46.9	18.5
	Exp.	"	374.8	76.3	177.0	17.02	6.84	30.12	12.10	47.2	8.0	3.23	223.1	39.5	15.9
	II. Pre.	"	199.1	40.2	94.1	17.32	6.93	16.30	6.52	47.3	8.2	3.27	234.1	40.6	16.2
	Exp.	"	380.6	89.8	182.3	17.43	7.04	31.77	12.83	47.9	8 3	3.37	203.0	35.4	14.3
	III. Pre.	"	195.8	38.8	92 4	17.95	7.27	16.59	6.72	47.2	8.5	3.43	238.2	42.8	17.3
	Exp.	"	404.8	94.3	151.0	18.35	7.33	27.71	11.07	37.3	6.8	2.74	160.2	29.4	11.7

‡ Sick for a few days.
* In total ration. † In experimental portion of ration.

Name of cow	Low, medium and high feeding / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten: In entire ration — Milk	In entire ration — Total solids	In entire ration — Fat	In experimental feed — Milk	In experimental feed — Total solids	In experimental feed — Fat
			lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
VERMONT UNA	IV. Pre.	Low	151.5	36.2	159.0	14.68	5.30	23.34	8.43	105.0	15.4	5.56	439.2	64.5	23.3
	Exp.	"	267.5	64.8	281.3	14.54	5.14	40.90	14.46	105.2	15.3	5.41	434.1	63.1	22.3
	V. Pre.	"	148.7	36.2	148.6	14.21	4.99	21.11	7.42	99.9	14.2	4.99	410.5	58.3	20.5
	Exp.	"	270.1	65.0	281.6	14.64	5.19	41.23	14.60	104.3	15.3	5.41	433.2	63.4	22.5
	VI. Pre.	"	146.9	36.1	151.0	14.56	5.15	21.99	7.78	102.8	15.0	5.30	418.3	60.9	21.6
	Exp.	"	263 7	64.9	263.9	14.52	5.14	38.33	13.57	100.1	14.5	5.15	406.6	59.0	20.9
PRETORIA	I. Pre.	Low	194.4	21.6	122.7	13.59	4.51	16.67	5.53	63.1	8.6	2.84	----	---	---
	Exp.	"	399.7	58.4	230.9	13 95	4.69	32.22	10.82	57.8	8.1	2.71	----	---	---
	II. Pre.	Medium	247.2	62.5	133.8	13.43	4.45	17 97	5.96	54.1	7.3	2.41	----	---	---
	Exp.	"	428.8	118.3	208.1	13.84	4.54	28.80	9.44	48.5	6.7	2.20	----	---	---
	III. Pre.	Low	202.5	32.7	107.4	14.13	4.69	15.17	5.04	53.0	7.5	2.49	----	---	---
	Exp.	"	407.7	63.2	186.3	13.92	4.60	25.95	8.57	45.7	6.4	2.10	----	---	---
	IV. Pre.	Medium	243.3	66.0	99.9	13.89	4.55	13 86	4.54	41.1	5.7	1.87	----	---	---
	Exp.	"	412.1	108.0	168.8	13.82	4.69	23.33	7.92	41.0	5.7	1.92	----	---	---
	V. Pre.	Low	191.8	30.8	89.3	13.75	4.39	12.28	3.92	46.6	6.4	2.04	----	---	---
	Exp.	"	368.0	60.5	147.6	13.72	4.59	20.25	6 78	40.1	5.5	1.84	----	---	---
	VI. Pre	Medium	224.9	63.1	79.8	13 97	4.75	11.15	3.79	35.5	5.0	1.69	----	---	---
	Exp.	"	395 0	108.1	131.7	13.79	4.62	18.16	6.09	33.3	4.6	1.54	----	---	---
PAULINE	I. Pre.	Medium	246.4	72.6	173.9	15.56	5.29	27.05	9.20	70.6	11.0	3.73	239.5	37.3	12.7
	Exp.	"	470.8	129 3	304.3	15.43	5.28	46.95	16.07	64.6	10.0	3.41	235.3	36.3	12.4
	II. Pre.	"	249.5	71.4	185.7	15.76	5.43	29.27	10.08	74.4	11.7	4.04	260.1	41.0	14.1
	Exp	"	439.6	126.5	307.6	15.49	5.32	47.64	16.37	70.0	10.8	3.72	243.2	37.7	12.9
	III. Pre.	"	239.9	70.7	141.7	16.41	5.82	23.25	8 25	59.1	9.7	3.44	200.4	32.9	11.7
	Exp.	"	469.5	128.2	283.7	15.41	5.32	43.73	15,10	60.4	9.3	3 22	221.3	34.1	11.8
	IV. Pre.	"	252.6	72.3	134.1	15.93	5.44	21.33	7 30	53.1	8.4	2,89	185.5	29.5	10.1
	Exp.	"	434.9	129.6	266.1	15.40	5.31	40.98	14.12	61.2	9.4	3.25	205.3	31.6	10.9
	V. Pre.	"	240 0	72.4	145.0	15.08	5.12	21.86	7.43	60.4	9.1	3.10	200.3	30.2	10.3
	Exp.	"	438.5	130.0	256.2	15.26	5.24	39.09	13.42	58.4	8.9	3 06	197.1	30.1	10.3
	VI. Pre.	"	236.3	72.2	143.9	15.02	5 15	21.62	7.41	60.9	9.2	3.13	199.3	29.9	10.3
	Exp.	"	417.7	129.7	227.9	14.69	5 06	33.48	11.54	54.6	8.0	2.76	175.7	25.8	8.9
INEZ	III. Pre.	Medium	243.5	70.8	242.6	15.32	5.59	37.16	13.57	99.6	15.3	5.57	----	---	---
	Exp.	"	478.8	126.0	424.2	14.96	5.32	63.46	22.58	88.6	13.3	4.72	----	---	---
	IV. Pre.	High	288.6	105.8	237.3	14.97	5.30	35.52	12.58	82 2	12.3	4.36	----	---	---
	Exp.	"	496.8	194.4	386.8	14.86	5.24	57.46	20.28	77.9	11.6	4.08	----	---	---
	V. Pre.	Medium	244.4	72 4	191.2	14.95	5.23	28.59	9.99	78.2	11.7	4.09	----	---	---
	Exp.	"	443.4	130.0	359.8	14.78	5.20	53 18	18.71	81.1	12.0	4.22	----	---	---
	VI. Pre.	High	267.7	104.6	200.8	14.61	5.15	29.34	10.34	75.0	11.0	3.86	----	---	---
	Exp.	"	453.5	173.9	365.6	14.65	5.17	53.54	18.89	80.6	11.8	4.17	----	---	---
POMONA	II. Pre.	Medium	236.2	69.7	244.5	15.72	5.69	38 43	13.91	103.5	16.3	5.89	350.8	55.1	20.0
	Exp.	"	433.0	120.2	442.7	14.92	5.41	66.04	23.96	102.3	15.3	5.53	368.3	54.9	19.9
	III. Pre.	"	243.7	70.7	248.1	14.61	5.24	36.23	13.01	101.8	14.9	5.34	351.0	51.3	18.4
	Exp.	"	475 7	128.2	444.5	14 17	4.9	62.99	21.87	93.4	13.2	4.60	346.7	49.1	17.1
	IV. Pre.	"	252.1	72.3	230.1	14.30	4.88	32.91	11.22	91.3	13.1	4.45	318.3	45.5	15.5
	Exp.	"	431.1	129.6	387.7	14.12	4.82	54.78	18.71	89.9	12.7	4.34	299.1	42.3	14.4

* In total ration. † In experimental portion of ration.

Name of cow	Low, medium and high feeding — Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten — In entire ration: Milk	Total solids	Fat	In experimental feed: Milk	Total solids	Fat
			lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
POMONA	V. Pre.	Medium	239.8	70.6	210.5	14.29	4.90	30.08	10.32	87.8	12.5	4.30	298.2	42.6	14.6
	Exp.	"	439.0	130.0	380.6	14.31	4.91	54.45	18.69	86.7	12.4	4.26	292.8	41.9	14.4
	VI. Pre.	"	236.2	72.2	211.2	14.21	4.80	30.02	10.14	89.4	12.7	4.29	292.5	41.6	14.0
	Exp.	"	419.3	124.3	378.9	14.42	5 02	54.63	19.03	90.4	13 0	4.54	304.8	44.0	15.3
LADY PERUSIA	I. Pre.	High	263.7	92.4	118.0	17.64	7.13	20.82	8.42	44.8	7.9	3.19	----	---	---
	Exp.	"	518.1	189.5	224.0	17.18	6.79	38.49	15 21	43.2	7.4	2.94	----	---	---
	II. Pre.	Medium	249.0	74.1	121.1	16.94	6.55	20.51	7.93	48.6	8.2	3.19	----	---	---
	Exp.	"	434.0	127.3	187.9	17.70	7.21	33.26	13.54	43.3	7.7	3 12	----	---	---
	III. Pre.	High	263.2	100.8	112.9	17.70	7.27	19.98	8.20	42.9	7.6	3.12	----	---	---
	Exp.	"	524.6	192.2	202.5	17.23	6.96	34.88	14.09	38.6	6.7	2.69	----	---	---
	IV. Pre.	Medium	247.0	72.3	103.3	17.12	6 83	17.68	7.05	41.8	7.2	2.85	----	---	---
	Exp.	"	436.6	129.6	186.2	16.91	6.75	31.40	12.57	42.7	7.2	2.88	----	---	---
	V. Pre.	High	274.8	105.0	113.5	16.54	6.56	18.77	7.44	41.3	6.8	2.71	----	---	---
	Exp.	"	479.7	185.1	216.9	16.44	6.46	35.65	14.02	45.2	7.4	2.92	----	---	---
	VI. Pre.	Medium	233.1	70.4	113.3	16.43	6.47	18.61	7.33	48.6	8.0	3.14	----	---	---
	Exp.	"	409.4	129.7	204.5	16.29	6.39	33.32	13.06	50.0	8.1	3.19	----	---	---
POWELLA	I. Pre.	High	249.1	94.2	144.5	17.53	7.00	25.32	10.11	58.0	10.2	4 06	153.4	26.9	10.7
	Exp.	"	510.4	193.1	275.4	17.17	6.67	47.29	18.37	54.0	9.3	3.60	142.6	24.5	9.5
	II. Pre.	"	272.2	107.2	152.6	17.02	6.48	25.97	9.88	56.1	9.5	3.63	142.4	24.2	9.2
	Exp.	"	471.6	189.7	234.6	17.19	6.68	40.32	15.67	49.8	8.6	3.32	123.7	21.3	8.3
	III. Pre.	"	257.0	105.2	100.5	17.48	6.93	17.56	6.96	39.1	6.8	2.71	95.5	16.7	6.6
	Exp.	"	499.2	178.0	152.3	17.20	6.67	26.19	10.15	30.4	5.3	2.03	85.6	14.7	5.7
RED TOP	I. Pre.	Medium	279.1	71.7	219.6	13.01	4.17	28.58	9.17	78.7	10.2	3.29	----	---	---
	Exp.	"	531.5	129.3	384.9	13.14	4.20	50.56	16.16	72.4	9.5	3.04	----	---	---
	II. Pre.	High	311.2	100.9	237.8	13.22	4.20	31.43	9.99	76.4	10.1	3.21	----	---	---
	Exp.	"	545.8	189.6	382.2	13.23	4.25	50.55	16.25	70.0	9.3	2.98	----	---	---
	III. Pre.	Medium	268.8	70.7	197.6	13.25	4.19	26.18	8.29	73.5	9.7	3.08	----	---	---
	Exp.	"	521.9	128.2	354.0	13.22	4.30	46.81	15.22	67.8	9.0	2.92	----	---	---
	IV. Pre.	High	308.9	105.8	202.6	13.21	4.18	26.77	8.46	65.6	8.7	2.74	----	---	---
	Exp.	"	528.9	186.3	349.9	13.18	4.24	46.13	14.82	66.2	8.7	2.80	----	---	---
	V. Pre.	Medium	257.1	68.8	176.3	12.94	4.12	22.84	7.27	68.6	8.9	2.83	----	---	---
	Exp.	"	481.1	129.1	333.4	13.13	4.23	43.79	14 09	69.3	9.1	2.93	----	---	---
	VI. Pre.	High	286.7	102.8	184.5	13.06	4.15	24.10	7.66	64.4	8.4	2.67	----	---	---
	Exp.	"	493.9	165.8	250.8	12.66	3.96	31.75	9 92	50.8	6.4	2.01	----	---	---
CERES	III. Pre.	High	274.8	100.0	320.4	14.53	4.90	46.53	15.69	116.6	16.9	5 71	320.4	46.5	15.7
	Exp.	"	491.8	157.5	595.2	14.45	4.95	86.01	29.47	121.2	17.5	5.99	377.9	54.6	18.7
	IV. Pre.	"	256.7	77.7	328.4	14.33	4.90	47.07	16.10	127.9	18.3	6.27	422.7	60.6	20.7
	Exp.	"	488.1	174.6	572.0	14.26	4.79	81.63	27.39	117.2	16.7	5.61	327.6	46.8	15.7
	V. Pre.	"	270 6	108.6	308.9	13.89	4.62	42.90	14.26	114.2	15.9	5.27	284.4	39.5	13.1
	Exp.	"	495.5	183.3	544.3	14 29	4.93	77.80	26.85	109.9	15.7	5.42	296.9	43.0	14.6
	VI. Pre.	"	276.9	108.2	292.4	14.05	4.70	41.08	13.74	105.6	14.8	4.96	270.3	38.0	12.7
	Exp.	"	480.7	181.1	536.0	14.04	4.75	75.27	25.46	111.5	15.7	5.30	296.0	41.6	14.1

* In total ration. † In experimental portion of ration.

Name of cow	Nos. 1 and 4 Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total soilds	Fat	Weight of products obtained per 100 lbs. of dry matter eaten: In entire ration — Milk	Total solids	Fat	In experimental feed — Milk	Total solids	Fat
			lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
FLORA	I. Pre.	No. 1	242.5	71.5	181.4	14.72	5.24	26.70	9.50	74.8	11.0	3.92	253.7	37.3	13.3
	Exp.	"	470.0	128.7	353 0	14.69	5.30	51.87	18.71	75.1	11.0	3.98	274.3	40.3	14.5
	II. Pre.	No. 4	225.0	50.0	201.7	14.24	5.00	28.73	10.09	89.6	12.8	4.48	403.4	57.5	20.2
	Exp.	"	403.8	97.7	296.9	14.71	5.26	43.67	15.61	73.5	10.8	3.86	303.9	44.7	16.0
	III. Pre.	No. 1	236.1	71 0	181.1	14 43	5.03	26.13	9.11	76.7	11.1	3.86	255.1	36.8	12.8
	Exp.	"	463.5	128.2	326.4	14.53	5.14	47.41	16.77	70.4	10.2	3.62	254.6	37.0	13.1
	IV. Pre.	No. 4	228.8	58.2	144.8	14.73	5.10	21.33	7.38	63.3	9.3	3.23	248.8	36.7	12.7
	Exp.	"	400.3	105.0	194.9	14.33	4.65	27.93	9.06	48.7	7.0	2.26	185.6	26.6	8.6
	V. Pre.	No. 1	231.4	70.1	79.2	14.36	4.94	11.37	3.91	34.2	4.9	1.69	113.0	16.2	5.6
	Exp.	"	427 1	127.9	116.5	13.84	4.50	16.12	5.24	27.3	3.8	1.23	91.1	12.6	4.1
FAIRIE	I. Pre.	No. 4	236.7	61.1	180.6	14.77	5.23	26.68	9.44	76.3	11.3	3.99	295.6	43.7	15.5
	Exp.	"	446.7	114.8	308.3	14.81	5.22	45.65	16.08	69.0	10.2	3.60	268.6	39.8	14.0
	II. Pre.	"	232.3	63.6	174.4	14.95	5.19	26.07	9.05	75.1	12.2	3.90	274.2	41.0	14.2
	Exp.	"	421 7	111.8	279.6	15.12	5.39	42.19	15.03	66.2	10.0	3.56	249.5	37.7	13.4
	III. Pre.	"	233.1	66.0	157.8	15.36	5.58	24.23	8.80	67.7	10.4	3.78	239.1	36.7	13.3
	Exp.	"	441.5	103.2	279.4	15.22	5.56	42.53	15.54	63.3	9.6	3 52	270.8	41.2	15.1
	IV. Pre.	"	240.9	63.5	144.3	14.94	5.29	21.56	7.63	59.9	9.0	3.17	227.3	34.0	12.0
	Exp.	"	390.5	90.5	248.8	14.78	5.23	36.76	13.00	63.7	9.4	3.33	274.9	40.6	14.4
	V. Pre.	"	220.3	58.4	145.4	14 61	5.06	21.24	7.35	66.0	9.6	3.34	249.0	36.4	12.6
	Exp.	"	398.7	99.2	273 4	14.73	5.06	40.26	13.82	68.6	10.1	3.47	275.6	40.6	13.9
	VI. Pre.	"	218.9	56.7	154.6	14.70	5.08	22.73	7.85	70.6	10.4	3.59	272.7	40.1	13.8
	Exp.	"	392.9	110.7	251.0	14.76	5.10	37.06	12.80	63.9	9.4	3.26	226.7	33.5	11.6
SADIE	I. Pre.	No. 1	245.7	71.5	202.8	14.56	4.87	29.52	9.87	82.6	12.0	4.02	283.7	41.3	13.8
	Exp.	"	477.7	128.7	364.8	14 34	4.91	52.32	17.92	76.4	11.0	3.75	283.5	40.7	13 9
	II. Pre.	No. 4	233.9	54.3	191.1	14.32	4.82	27.37	9.21	81.7	11.7	3.94	351.9	50.4	17.0
	Exp.	"	397.0	84 0	303.2	14.35	4.83	43.52	14.65	76.4	11.0	3.69	361.0	51.8	17.4
	III. Pre.	No. 1	235.6	69 3	166.4	14.43	4.78	24.01	7.95	70.6	10.2	3.37	240.1	34.6	11.5
	Exp.	"	468.9	127.3	304.8	14.15	4.72	43 12	14.38	65.0	9.2	3.07	239.4	33.9	11.3
	IV. Pre.	No. 4	224.0	49.5	153.8	13.94	4.56	21.44	7.01	68.7	9.6	3.13	310.7	43.3	14.2
	Exp.	"	417.7	109 5	265.6	14.23	4.82	37.78	12.79	63 6	9.0	3.06	242.5	34.5	11.7
	V. Pre.	No. 1	239.4	70.2	152.0	14.34	4.89	21.80	7.43	63.5	9.1	3.10	216.5	31.1	10.6
	Exp.	"	430.0	127.0	279.6	14.09	4.77	39.40	13.33	65.0	9.2	3.10	220.2	31.0	10.5
	VI. Pre.	No. 4	224.2	60.2	142.4	14.03	4.80	19.98	6.83	63.5	8.9	3.05	236.5	33.2	11.3
	Exp.	"	395.6	107.3	255.4	13.81	4.60	35.26	11.74	64.6	8.9	2.97	238.0	32.9	10.9
EDITH	I. Pre.	No. 1	247.4	71.5	178.5	15.05	5.20	26.87	9.28	72.2	10.9	3 75	249.7	37.6	13.0
	Exp.	"	472.4	128.7	318.1	14.95	5.16	47.56	16.43	67.3	10.1	3.48	247.2	37.0	12.9
	II. Pre.	"	249.1	71.4	179.7	15.14	5.23	27.21	9.39	72.1	10.9	3.77	251.7	38.1	13.2
	Exp.	"	439 0	127.6	304.8	15.12	5.30	46.06	16.15	69.4	10.5	3.68	238.9	36.1	12.7
	III. Pre.	"	236.6	71.0	170.6	15.17	5.30	25.88	9.04	72.1	10.9	3.82	240.3	36.5	12.7
	Exp.	"	471.0	128.2	308.5	14.97	5.25	46.18	16.19	65.5	9.8	3.44	240.7	36.0	12.6
	IV. Pre.	"	242.1	71.0	164.9	15.26	5.37	25.16	8.86	68.1	10.4	3.66	232.3	35.4	12.5
	Exp.	"	428.8	118.0	294.9	15.03	5.30	44.33	15.62	68.8	10.3	3.64	230.4	34.6	12.2
	V. Pre.	"	235.5	71.0	156.9	15.16	5.49	23.79	8.62	66.6	10.1	3.66	221.0	33.5	12.1
	Exp.	"	422.4	126.1	296.3	15.06	5.33	44.61	15.80	70.1	10.6	3.74	235.0	35.4	12.5
	VI. Pre.	"	228.0	69.4	162.2	14.75	5.25	23.92	8.51	71.1	10.5	3.73	233.7	34.5	12.3
	Exp.	"	403.7	125.8	276.2	14.80	5.24	40.88	14.46	68.4	10.1	3.58	279.5	32.5	11.5

*** In total ration. † In experimental portion of ration.**

Name of cow	Nos. 4 and 5 / Period numbers	Experimental ration	Dry matter eaten*	Dry matter eaten†	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten: In entire ration — Milk	Total solids	Fat	In experimental feed — Milk	Total solids	Fat
			lbs	lbs	lbs	%	%	lbs	lbs	lbs	lbs	lbs	lbs	lbs	lbs
EUNICE	I. Pre.	No. 3	221.7	46.7	162.5	14.56	5.03	23.65	8.18	73.3	10.7	3.69	348.0	50.6	17.5
	Exp.	"	457.3	108.3	271.3	14.37	4.75	38.98	12.88	59.3	8.5	2.82	250.5	36.0	11.9
	II. Pre.	No. 1	258.7	71.4	158.8	14.82	5.08	23.53	8.06	61.4	9.1	3.12	222.4	33.0	11.3
	Exp.	"	453.0	128.4	252.6	14.82	5.13	37.44	12.95	55.8	8.3	2.86	196.7	29.2	10.1
	III. Pre.	No. 3	222.8	49.8	134.2	14.66	4.95	19.67	6.64	60.2	8.8	2.98	269.5	39.5	13.3
	Exp.	"	473.2	125.5	231.3	14.82	5.18	34.29	11.97	48.9	7.3	2.53	184.3	27.3	9.5
	IV. Pre.	No. 1	252.9	71.0	112.9	14.95	5.30	16.87	5.98	44.6	6.7	2.36	159.0	23.8	8.4
	Exp.	"	436.1	128.0	194.3	14.84	5.21	28.83	10.13	44.6	6.6	2.32	151.8	22.5	7.9
	V. Pre.	No. 3	241.7	68.8	113.1	14.66	5.08	16.58	5.75	46.8	6.9	2.38	164.4	24.	8.4
	Exp.	"	414.8	113.8	203.3	14.85	5.25	30.19	10.68	49.0	7.3	2.57	178.6	26.5	9.4
	VI. Pre.	No. 1	234.2	65.9	119.7	14.84	5.18	17.76	6.20	51.1	7.6	2.65	181.6	27.0	9.4
	Exp.	"	414.2	124.0	212.7	14.76	5.24	31.39	11.14	51.4	7.6	2.69	171.5	25.3	9.0
NAOMI	II. Pre.	No. 4	209.2	41.6	154.3	14.26	4.29	22.00	6.62	73.8	10.5	3.16	370.9	52.9	15.9
	Exp.	"	389.8	80.0	289.6	14.08	4.22	40.77	12.21	74.3	10.5	3.13	362.0	51.0	15.3
	III. Pre.	No. 5	239.9	69.8	169.3	14.1.	4.29	23 88	7.26	70.6	10.0	3.03	242.7	34.2	10.4
	Exp.	"	469.8	126.0	308.3	14.07	4.28	43.37	13.18	65.6	9.2	2.81	244.7	34.4	10 5
	IV. Pre.	No. 4	221.3	40.5	155.7	14.03	4.27	21.84	6.65	70.4	9.9	3.01	384.5	53.9	16.4
	Exp.	"	368.5	63.5	269.5	13.94	4.26	37.58	11.48	73.1	10.2	3.12	424.4	59.2	18.1
	V. Pre.	No. 5	236.2	69.8	150.0	13.99	4.30	20.99	6.45	63.5	8.9	2.73	214.9	30.1	9.1
	Exp.	"	416.7	126.3	274.8	14.09	4.43	38.72	12.16	65.0	9.3	2.92	217.6	30.7	9.6
	VI. Pre.	No. 4	216.4	51.4	148.0	13.89	4.35	20.56	6.44	68.4	9.5	2.98	288.0	40.0	12.5
	Exp.	"	359.4	83.7	273.6	13.93	4.40	38.12	12.04	76.1	10.6	3.35	326.4	45.5	14.4
PRIMROSE	II. Pre.		----	----	----	----	-.-	----	----	-.-	-.-	-.-	-.-	-.-	-.-
	Exp.	No. 5	425.1	104.1	315.8	13.78	4.40	43.52	13.90	74.3	10.2	3.27	303.4	41.8	13.4
	III. Pre.	"	240.3	68 7	183.4	14.04	4.58	25.74	8.39	76.3	10.7	3.49	167.9	37.5	12.1
	Exp.	"	475.2	126.0	343.7	13.79	4.39	47.39	15.08	72.3	10.0	3.17	172.8	37.6	12.0
	IV. Pre.	"	248.7	69 8	182.3	13.99	4.50	25.30	8.20	73.3	10.3	3.30	161.2	36.5	11.7
	Exp.	"	431.2	125.7	327.5	13.83	4.41	45.29	14.45	75.9	10.5	3.35	160.6	36.0	11.5
	V. Pre.	"	239.9	68.8	178.7	13.78	4.43	24.62	7.91	74.5	10.3	3.30	159.7	35.8	11.5
	Exp.	"	436.2	127.2	313 4	13.95	4.53	43.72	14.19	71.8	10.0	3.25	146.4	34.4	11.1
	VI. Pre.	"	233.6	70.0	179.3	13.64	4.34	24.46	7.79	76.8	10.5	3.33	156.2	34.9	11.1
	Exp.	"	423.1	127.0	326.0	13.56	4.31	44.19	14.04	77.1	10.4	3.32	156.7	34.8	11.1
MINTA BELLE	I. Pre.	No. 4	----	----	----	----	-.-	----	----	-.-	-.-	-.-	-.-	-.-	-.-
	Exp.	"	428.2	99.7	245.7	16.98	6.88	41.72	16.89	57.4	9.7	3.94	246 4	41.8	16.9
	II. Pre.	No. 5	245.7	63.5	149.5	16.94	6.70	25.33	10.02	60.8	10.3	4.08	218.3	37.0	14.6
	Exp.	"	431.5	123.1	244.4	17.05	6 79	41.68	16.59	56.6	9.7	3.85	198.5	33.9	13.5
	III. Pre.	No. 4	229.3	61.6	133.1	17.17	6.95	22.85	9.25	58.1	10.0	4 03	216.1	37.1	15.0
	Exp.	"	442.2	101.4	227.2	16.81	6.65	38.18	15.11	51.4	8.6	3.42	224.1	39.7	24.9
	IV. Pre.	No. 5	247.6	69 0	123.0	16.77	6.73	20.59	8.28	49.7	8.3	3.34	178.3	29.8	12.0
	Exp.	"	423.4	121.3	214.9	16.45	6.58	35.35	14.14	50.8	8.3	3.34	177.2	29.1	11.7
ROSEL	II. Pre.	No. 5	242.4	70.2	135.9	16.87	6.20	22.93	8.43	56.1	9.5	3.48	193.6	32.7	12.0
	Exp.	No. 4	422.0	126.5	191.5	17 48	6.37	33.48	12.20	45.4	7.9	1.89	151.4	26.5	9 6
	III. Pre.	"	238.1	70.4	92.6	17.94	6.54	16.61	6.06	38.9	7.0	1.55	131.5	23.6	8.6
	Exp.	"	458.4	127.0	160.4	17.37	6.21	27.85	9.96	35.0	6 1	1.17	126.3	21.9	7 8
	IV. Pre.	"	244.3	69.7	78.2	17.42	6.25	13.62	4.89	32.0	5.6	1.00	112.2	19.5	7.0
	Exp.	"	350.0	72.1	118.8	17.51	6.48	20.80	7.70	33.9	5.9	1.20	164.8	28.9	10.7

*** In total ration. † In experimental portion of ration.**

Name of cow	Nos. 4 and 5; silage and pomace / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten: In entire ration — Milk	Total solids	Fat	In experimental feed — Milk	Total solids	Fat
			lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
DOROTHY	III. Pre.	No. 4	194.0	41.4	150.6	14.69	4.77	22.12	7.19	77.6	11.4	3.71	363.8	53.4	17.4
	Exp.	"	386.3	75.0	258.4	14.10	4.50	36.44	11.62	66 9	9.4	3.01	344.5	48.6	15.5
	IV. Pre.	No. 5	213.7	52 9	131.5	14.58	4.93	19.18	6.48	61.5	9.0	3.03	248.6	36.3	12.3
	Exp.	"	367.7	89.0	226.8	14.26	4.73	32.34	10.73	61.7	8.8	2.92	254.8	36.3	12.1
	V. Pre.	No. 4	178.0	40.1	122.3	14.09	4.70	17.23	5.75	68.6	9.7	3 23	305.0	43.0	14.3
	Exp.	"	319.5	60.4	220.2	14.23	4.79	31.33	10.55	68.9	9.8	3.30	364.6	51.9	17.5
	VI. Pre.	No. 5	179.7	48.2	122.1	14.34	4.92	17.51	6.01	68.0	9.7	3.34	153.3	36.3	12.5
	Exp.	"	334.9	83.8	215.1	14.47	4.98	31.12	10.71	64.2	9.3	3.20	156.7	37.1	12.8
HALLOW'EN	IV. Pre.	No. 5	----	----	----	----	---	----	----	--	--	--	----	---	---
	Exp.	"	424.5	125.7	408.2	14.47	4.80	59.07	19.57	96.2	13.9	4.61	324.7	47.0	15.6
	V. Pre.	"	235.5	69.7	220.1	14.75	5.12	32.47	11.27	93.5	13.8	4.79	315.8	46.6	16.2
	Exp.	"	431.7	126.3	385.6	14.72	5.07	58.22	20.07	91.6	13.5	4.65	313.2	46.1	15.9
	V. Pre.	"	233.9	70.0	220.0	14.35	4.85	31.56	10.67	94.1	13.5	4.56	314.3	45.1	15.2
	Exp.	"	421 6	127.0	370.6	14.66	5.18	54.34	19.18	87.9	12.9	4.55	291.8	42.8	15.1
ATALANTA	II. Pre.	Silage	252.8	82.4	138.6	11.22	3.56	16.94	4.92	54.8	6.7	1.95	168.2	25.6	6.0
	Exp.	"	441.3	134.7	231.1	11.63	3.92	29.18	9.07	52.4	6.6	2.06	171.6	21.7	6.7
	III. Pre.	Pomace	226.6	57.6	122.4	11.82	4.02	15.69	4.92	54.0	6.9	2.17	212.5	27.2	8.5
	Exp.	"	424.6	119.4	207.7	11.78	4.05	26.53	8.40	48.9	6.3	1.98	173.9	22.2	7.0
	IV. Pre.	Silage	243.2	80.1	109 6	11.89	4.10	14.13	4.49	45.1	5.8	1.85	136.8	17.6	5.6
	Exp.	"	420.4	129.2	185.4	11.81	3.98	23.74	7.37	44.1	5.7	1.75	143.5	18 4	5.7
	V. Pre.	Pomace	224.7	59.7	93.9	11.68	4.10	11.91	3.85	41.8	5.3	1.71	157.3	20.0	6.5
	Exp.	"	407.2	105.7	121.9	13.11	4.25	15.98	5.18	29 9	3.9	1.27	115.3	15.1	4.9
SURPRISE	III. Pre.	Silage	----	----	----	----	---	----	----	--	--	--	----	---	---
	Exp.	"	300.1	111.0	209.5	14 23	4.25	29.81	8.90	69.8	9.9	2.97	188.7	26.9	8.0
	IV. Pre.	Pomace	154.4	41.2	120.2	14.24	4.55	17.11	5.47	77.9	11.1	3.54	291.8	41.5	13.3
	Exp.	"	277.4	69.2	218.4	14.33	4.63	31.29	10.11	78.7	11.3	3.65	315.6	45.2	14.6
	V. Pre.	Silage	165.8	50.2	115.5	14.30	4.65	16.52	5.37	69.7	10.0	3.24	230.1	32.9	10.7
	Exp.	"	299.3	87.3	205.4	14.52	4.81	29.83	9.89	68.6	10.0	3.30	235.3	34.2	11.3
JERSEY LILY, 2nd	I. Pre.	Pomace	156.3	44.3	87.7	17.29	6.92	15.16	6.07	56.1	9.7	3.88	198.0	34.2	13.7
	Exp.	"	280.6	78.6	165.4	17.24	6.92	28.51	11.44	58.9	10.2	4.08	210.5	36.3	14.6
	II. Pre.	"	164.0	44.4	90.9	17.26	6.90	15.68	6.27	55.4	9.6	3.82	204.7	35.3	14.1
	Exp.	"	312.4	95.3	153.3	17.43	7.15	26.71	10.95	49.1	8.6	3.50	160.8	28.0	11.5
	III. Pre.	"	159.9	39.6	81.4	17.85	7.40	14.53	9.03	50.9	9.1	3.77	205.6	36.7	15.2
	Exp.	"	296.3	85.5	148 2	17.54	7.17	26.01	10.63	50.0	8.8	3.59	173.3	30.4	12.4
	IV. Pre.	"	164.8	44.7	82.8	17.27	6.98	14.30	5.78	50.2	8.7	3.51	185.2	32.0	12.9
	Exp.	"	299.4	79.9	146.0	17.01	6.81	24.83	9.95	48.8	8.3	3.32	182.7	31.1	12.5
	V. Pre.	"	157.9	37.9	80.7	16.98	6.83	13.70	5.51	51.1	8.7	3.49	213 0	36.2	14.5
	Exp.	"	276.7	62.1	152.2	16.85	6.73	25.65	10.24	55.0	9.3	3.70	245.1	41.3	16.5

* In total ration. † In experimental portion of ration.

Name of cow	Silage and pomace / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten: In entire ration — Milk	Total solids	Fat	In experimental feed — Milk	Total solids	Fat
			lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
LAVENDER	II. Pre.	Silage	248.9	85.6	166.6	16.06	6.18	26.75	10.29	66.9	10.7	4.13	194 6	31.3	12.0
	Exp.	"	443.5	139.5	259 6	16.13	6.21	41.88	16.13	58.5	9.4	3.64	186.1	30.0	11.6
	III. Pre.	Pomace	232.2	57.9	148.3	16.16	6.33	23.97	9.38	63.9	10.3	4.04	256.0	41.4	16.2
	Exp.	"	425.2	119.4	263.2	16.03	6.27	42.19	16.49	61.8	9.9	3.88	230.5	35.3	13.8
	IV. Pre.	Silage	251.6	81.1	140.4	16.11	6.33	22.62	8.89	55.8	9.0	3.53	173.1	27.9	11.0
	Exp.	"	430.3	129.2	247.5	15.66	6.02	38.77	14.91	57.5	9.0	3.47	191 6	30.0	11.5
	V. Pre.	Pomace	226.7	60.0	137.8	15.85	6.13	21.83	8.44	60.8	9.6	3.72	129.7	36.4	14.1
	Exp.	"	414.1	108.1	256.9	15.62	6.00	40.14	15.42	62.0	9.7	3.72	137.7	37.1	14.3
	VI. Pre.	Silage	239.2	70.7	144.7	15.23	5.72	22.04	8.28	60.5	9.2	3.46	104 7	31.2	11.7
	Exp.	"	424.9	117.5	265.9	15.43	5.89	41.04	15.65	62.6	9.7	3.68	126.3	34.9	13.3
SYLVIA	I. Pre.	Silage	276.5	70.3	152.9	14.81	5.10	22.63	7.80	55.3	8.2	2.82	217.5	32.2	11.1
	Exp.	"	534.6	168.1	289.3	14.70	4.99	42.54	14.44	54.2	8.0	2.71	172.1	25.3	8.6
	II. Pre.	Pomace	261.6	63.5	152.7	15.31	5.34	23.37	8.19	58.4	8.9	3.13	240.2	36.8	12.9
	Exp.	"	488.2	126.9	240.7	15.54	5.54	37.40	13.34	49.3	7.7	1.73	189.7	19.5	10.5
	III. Pre.	Silage	276.7	71.5	125.2	15.55	5.55	19.46	6.95	45.3	7.0	1.51	175.1	17.2	9.7
	Exp.	"	534.1	170.6	221.4	15.48	5.52	34.24	12.22	41.5	6.4	1.29	129.8	10.1	7.2
	IV. Pre.	Pomace	267.5	65.2	110.9	15.68	5.55	17.39	6.16	41.5	6.5	1.30	170.1	16.7	9.4
	Exp.	"	458.5	103.4	157.0	16.21	5.92	25.45	9.30	34.2	5.6	1.03	151.8	14.6	9.0
MONA	I. Pre.	Pomace	299.9	58.2	170.1	14.44	4.98	24.56	8.46	56.7	8.2	1.82	192.3	42.2	14.5
	Exp.	"	536.9	114.4	295.1	14.45	5.06	42.64	14.92	55.0	7.9	1.78	158.0	37.3	13.0
	II. Pre.	"	303.9	63.0	161.1	14.64	5.13	23.59	8.26	53.0	7.8	1.72	155.7	37.4	13.1
	Exp.	"	554.8	125.6	277.5	14.65	5.15	40.65	14.28	50.0	7.3	1.57	121.0	32 4	11.4
	III. Pre.	"	259.2	56.6	153.3	14.75	5.30	22.59	8.13	59.1	8.7	3.14	170.9	39.9	14.6
	Exp.	"	478.4	118.1	274.6	14.63	5.13	40.14	14.97	57 4	8.4	1.94	132.5	34.0	11.0
	IV. Pre.	"	263.5	56.3	151.1	14.55	5.08	21.98	7 67	57.3	8.3	1.91	168.4	39.0	13.4
	Exp.	"	467.4	96.0	268.4	14.36	4.97	38.54	13.34	57.4	8.3	1.85	179.6	40.1	13.9
	V. Pre.	"	233.9	46.1	145.8	14.44	5.06	21.06	7.37	62.3	9.0	3.15	316.3	45.7	16.9
	Exp.	"	452.4	79.1	272.1	14.23	4.90	38.73	13.32	60.1	8.6	2.94	344.0	49.0	16.8
PHYLLIS	I. Pre.	Silage	250.1	70.3	231.4	14.09	4.40	32.55	10.19	92.5	13.0	4.07	329.2	46.3	14.5
	Exp.	"	476.9	66.9	410.3	13.97	4.40	57.32	18.01	86.0	12.0	3.78	245.8	34.3	10.8
	II. Pre.	Pomace	239.5	164.5	213.3	13.96	4.40	29.74	9.38	89.1	12.4	3.92	330.7	46.1	14.5
	Exp.	"	437.3	125.4	358.7	13.96	4.48	50.06	16.08	82.0	11.4	3.68	286.1	39.9	12.8
	III. Pre.	Silage	245.8	71.5	185 0	14.17	4.60	26.19	8.51	75.3	10.7	3.46	258.8	36.6	11.9
	Exp.	"	473.5	167.5	304.6	13.75	4.34	41.85	13.23	64.3	8.8	2.79	181.9	25.0	7.9
	IV. Pre.	Pomace	233.0	59.5	158.8	13.84	4.40	21.98	6.99	68.2	9.4	3.00	266.9	36 9	11.7
	Exp.	"	415.6	99.7	275.8	13.65	4.31	37.66	11.88	66.4	9.1	2.86	276.6	37.8	11.9
	V. Pre.	Silage	243.0	75.4	148.7	13.70	4.25	20.37	6 32	61.2	8.4	2.60	197.2	27.0	8.4
	Exp.	"	436.8	127.3	262.1	13.83	4.35	36.24	11.39	60.0	8.3	2 61	205.9	28.5	9.0
SONOMA	I. Pre.	Pomace	212.8	57.2	191.0	5.06	5.22	28.75	9.97	89.8	3.5	4.69	333.9	50.3	17.4
	Exp.	"	376.1	113 4	341.9	4.85	5.12	50.81	17.52	90.9	3.5	4.66	301.5	44.8	15.5
	II. Pre.	Silage	221.9	79.1	194.7	4.87	5.00	28.95	9.74	87.7	3.0	4.39	246.1	36.6	12.3
	Exp.	"	409.0	138.0	329.6	5.03	5.19	49.61	17.11	80.6	2.1	5.18	238.8	35.9	12.4
	III. Pre.	Pomace	212.6	57.9	179.9	5.03	5.42	27.05	9.75	84.6	2.7	4.59	310.7	46.7	16.8
	Exp.	"	393.2	118.3	330.2	4.96	5.21	49.38	17.21	84.0	2.6	4.38	280.0	41.8	14.8
	IV. Pre.	Silage	237.7	81.1	181.4	4.99	5.18	27.10	9.39	76.3	1.4	3.95	223.7	33.5	11.6
	Exp.	"	305.7	128.9	321.6	4.81	5 05	47.66	16.24	79.3	1.7	4.00	249.5	37.0	12 6
	V. Pre.	Pomace	208.2	56.6	175 1	4.89	5.1	26.08	8.98	84.1	1.5	4.31	309.4	46.1	15.9
	Exp.	"	385.9	104.8	328.0	5.08	5.30	49.46	17.38	85.0	1.8	4.50	313.0	47.2	16.6
	VI. Pre.	Silage	216.1	70.7	185.7	4.73	5.08	27.35	9.43	85.9	1.7	4.36	262.7	38.7	13.3
	Exp.	"	383.5	117.2	320.9	4.68	5.01	47.09	16.06	83.7	1.3	4.19	273.8	40.2	13.7

* In total ration. † In experimental portion of ration.

Name of cow	King gluten meals / Period numbers	Experimental ration	Dry matter eaten *	Dry matter eaten †	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter eaten: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In experimental feed: Milk	In experimental feed: Total solids	In experimental feed: Fat
			lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
CRYS'L GIRL	IV. Pre.	No 1	----	----	----	----	---	----	----	---	---	---	----	---	---
	Exp.	"	367.7	96.0	321.4	13.34	3.71	42.88	11.93	87.4	11.7	3.24	334.8	44.7	12.4
	V. Pre.	"	209.6	51.5	163.5	13.42	4.02	21.94	6.58	78.0	10.5	3.14	317.5	42.6	12.8
	Exp.	"	378.5	95.9	292.8	13.33	3.92	39.04	11.48	77.4	10.3	3.03	305.3	40.7	12.0
	VI. Pre.	"	207.0	52.5	159.3	13.36	3.97	21.29	6.34	77.0	10.3	3.06	303.4	40.6	12.1
	Exp.	"	370.9	96.2	272 1	13.21	3.87	35.93	10.54	73.4	9.7	2.84	282.8	37.3	10.9
BEAUTINA	IV. Pre.	No. 6	243.7	71.2	309.1	13.89	4.60	42.94	14.23	126.8	17.6	5.84	434.1	60.3	20.0
	Exp.	"	428.7	126.3	531.1	13.80	4.55	73.31	24.19	123.9	17.1	5.64	420.6	58 1	19.2
	V. Pre.	No. 7	235.7	71.2	267.4	13.71	4.65	36.66	12.43	113.5	15.6	5.27	375.6	51.5	17.5
	Exp.	"	436.7	127.7	495.2	13.89	4.60	68.77	22.78	113.4	15.7	5.22	387.8	53.9	17.8
	VI. Pre.	No. 6	228.2	70.6	263.3	14.08	4.79	37.08	12.62	115.4	16.3	5.53	372.9	52.5	17.9
	Exp.	"	420.5	127.2	444.7	14.04	4.77	62.43	21.23	105.7	14 8	5.05	349.6	49.1	16.7
MAX ELLA	III. Pre.	No. 6	238.3	69.7	330.8	14.03	4.57	46.40	15.11	138.8	19.5	6.34	474.7	66.6	21.7
	Exp	"	466.4	126.1	601.9	13.68	4.36	82.39	26.25	129.0	17.7	5.63	477.3	65.3	20.8
	IV. Pre.	No. 7	249.4	70.9	317.2	13.80	4.45	43.76	14.10	127.2	17.5	5.65	447.4	61.7	19.9
	Exp.	"	432.6	128.2	562.0	13.76	4.41	77.33	24.80	129.9	17.9	5.73	438.4	60.3	19.3
	V. Pre.	No. 6	234.4	70.7	299.7	13.84	4.57	41.49	13.71	127.9	17.7	5.85	423.9	58.7	19.4
	Exp.	"	433.5	127.2	536.9	13.93	4.53	74.78	24.33	123.9	17.3	5.61	422.1	58.8	19.1
	VI. Pre.	No. 7	230 4	70.1	296.0	13.55	4.30	40.11	12.73	128.5	17.4	5.52	422.3	57.2	18.2
	Exp.	"	420.1	128.2	499.5	13.46	4.33	67.24	21.64	118.9	16.0	5.15	389.6	52.5	16.9
HAIDEE	III. Pre.	No. 6	----	----	----	----	---	----	----	----	---	---	----	---	---
	Exp.	"	466.0	126.1	582.6	14.51	4.95	84.54	28.86	125.0	18.1	6.19	462.0	67.0	22.9
	IV. Pre.	No. 7	254.5	70.9	291.4	14.45	4.90	42.10	14.28	114.5	16.5	5.61	411.0	59.4	20.2
	Exp.	"	439.0	128.2	503.3	14.34	4.77	72.19	24.00	114.7	16.4	5.47	392.6	56.3	18.7
	V. Pre.	No. 6	237.6	72.5	264.3	14.74	5.07	38.95	13.41	111.2	16.4	5.64	364.5	53.7	18.5
	Exp.	"	440.6	127.2	468.6	14.90	5.20	69.81	24.36	106.4	15.8	5.53	368.4	54.9	19.2
	VI. Pre.	No. 7	242.2	71.2	250.9	14.77	5.20	37.07	13.05	103 6	15.3	5.39	352.4	52.1	18.3
	Exp.	"	420.1	128.2	431.2	14.95	5.31	64.45	22.91	102.6	15.3	5.45	336.4	50.3	17.9
STAR BRIGHT	III. Pre.	No. 7	243 0	70.8	230.2	15.43	5.40	35.55	12.44	94.7	14.6	5.12	325.2	50.2	17.6
	Exp.	"	472.0	126.7	390.6	15.43	5.50	60.25	21.49	82.8	12.8	4 58	308.3	47.6	17.0
	IV. Pre.	No. 6	251.1	70.1	194.7	14.88	5.05	28.97	9.79	77.5	11.5	3.90	277.8	41.3	14.0
	Exp.	"	432.5	127.2	307.5	15.11	5.25	46.46	16.15	71.1	10.7	3.73	241.8	36.5	12.7
	V. Pre.	No. 7	241.0	71.2	169.6	15 24	5.35	25.85	9.08	70.4	10.7	3.77	238.2	36.3	12.8
	Exp.	"	437 3	127.7	315.0	15.28	5.44	48 14	17.13	72.0	11.0	3.92	246.7	37.7	13.4
	VI. Pre.	No. 6	235.7	70.6	171.3	15.21	5.45	26.06	9.34	72.7	11.1	3.96	242.6	36.9	13.2
	Exp.	"	417.1	126.1	305.2	15.21	5.42	46.42	16.54	73.2	11.1	3 97	242.0	36.8	13.1

* In total ration. † In experimental portion of ration.

VI. DIFFERENCE TABLES. (*a*) TOTALS OF DIFFERENCES; (*b*) PERCENTAGE DIFFERENCES

[Showing differences in experimental feeding between the average of the results of two periods on one ration (the second named in the following tables) and those actually obtained with another ration (the first named in the following tables) in the intervening period.]

(*a*) TOTALS OF DIFFERENCES

RATIONS	Periods represented	Total dry matter eaten	Dry matter eaten in experimental feed	Weight of products obtained per 100 lbs. of dry matter: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In experimental feed: Milk	In experimental feed: Total solids	In experimental feed: Fat
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.
No. 2.															
Low to medium	3	+214.0	+189.5	+ 71.6	+0.04	+0.13	+11.80	+ 4.98	− 6.9	−1.2	−0.40	.....	.....	.....
Medium to low	5	−273.4	−301.3	−129.5	−0.39	−0.43	−21.60	− 8.82	+ 6.2	+0.4	−0.03	.....	.....	.....
Medium to high	6	+247.0	+272.5	− 15.7	+0.29	+0.25	− 1.92	− 0 30	−40.8	−6.0	− 1.97	.....	.....	.....
High to medium	5	−221.1	−241.7	+ 2.3	−0.19	−0.31	+ 0.29	− 0.45	+32.4	+4.9	+1.62	.....	.....	.....
No. 3.															
Low to medium	6	+391.1	+368.4	+168.9	+0.48	+0.39	+27.00	+10.20	−41.5	−5.7	−1.62	.....	.....	.....
Medium to low	5	−299.5	−292.8	−201.4	+0.03	−0.07	−28.70	− 9.68	+11.0	+1.3	+0.46	.....	.....	.....
Medium to high	5	+228.2	+303.9	+ 50.6	−0.15	−0.18	+ 7 57	+ 2.58	−14.7	−2.6	−0.95	.....	.....	.....
High to medium	5	−230.7	−283.7	− 44.4	+0.80	+0.54	− 6.21	− 2 08	+15.5	+2.5	+1.01	.....	.....	.....
No. 2.															
Low	5	− 12.3	− 6.9	+ 8.8	+0.01	0	+ 0.75	+ 0.14	+ 3 7	+0.4	+0.14	+ 88.4	+10.4	+ 2.7
Medium	7	+ 23.2	+ 1.2	+ 23.1	−0.10	−0.16	+ 2.62	+ 0.22	− 0.5	−0.3	−0.20	+ 14.7	+ 1.4	− 0.3
High	7	+ 47.9	+ 19.4	+ 5.6	−0.05	−0.06	+ 0.43	+ 0.19	− 8.1	−1.5	−0.42	− 26.8	− 4.3	− 1.6
No. 3.															
Low	5	+ 7.8	− 0.7	+ 2.1	+0.09	0.12	+ 0.92	− 0 05	−10.7	−1.2	−0.06	+ 6.1	+ 1.7	0
Medium	7	+ 25.8	+ 5.4	+ 17.4	−0.13	−0.21	+ 1.53	+ 0.86	− 1.8	−1.6	−0.32	− 2.3	− 1.2	− 1.1
High	3	− 27.7	+ 13.7	+ 13.2	+0.03	+0.02	+ 2.65	+ 1.06	+ 4.7	+0.9	+0.36	− 15.1	− 1.5	− 0.6
No. 1 to No. 4	4	−216.1	−115.6	−127.6	+0.45	−0.05	− 7.49	− 6.65	+ 4.8	+0.9	+0.14	+163.3	+24.3	+ 7.8
No. 4 to No. 1	3	+146.2	+ 75.9	+120.0	−0.06	+0.13	+16.96	+ 6.15	+ 5.2	+0.7	+0.33	− 72.7	− 7.7	− 3.3
No. 4 to No. 5	4	+154.4	+150.7	+ 27.3	+0.45	+0.24	+ 5.24	+ 1.96	−20.7	−2.6	−0 71	.....	.....	.....
No. 5 to No. 4	3	− 91.9	−109 5	− 25.4	−0.22	−0.21	− 4.21	− 1.62	+10.9	+1.2	+0.31	.....	.....	.....
No. 1 to No. 3	2	+ 18 2	− 14.9	+ 7.6	+0.04	+0.03	+ 1.28	+ 0.47	− 0 3	+0.1	0	+ 26.9	+ 4.0	+ 1.4
No. 3 to No. 1	2	− 20.2	+ 20.1	− 21.9	+0.22	+0.15	− 2.61	− 0.68	+ 2.7	−0.3	−0.05	− 50.4	− 6.9	− 2.2
No. 6 to No. 7	4	− 7.1	+ 4.9	− 13.8	−0.33	−0.21	− 3.56	− 2.25	+ 0.8	−0.4	−0.34	− 26.4	− 5.2	− 2.8
No. 7 to No. 6	3	− 4.1	− 2.0	− 37.9	+0.32	+0.10	− 3.76	− 1.15	− 9.1	−1.0	−0.27	− 23.7	− 2.2	− 0.6
Silage to pomace	9	−199.5	−238.4	+ 9.8	+0.99	+1.10	+ 4.54	+ 3.80	+40.7	+5.9	+2.51	+460.9	+68.5	+ 24.9
Pomace to silage	6	+163.5	+181.8	+ 3.8	−0.86	−0.75	− 1.37	− 1.64	−22.1	−3.9	−1.52	−405.2	−61.9	− 22.4
No. 4 to No. 4	5	+ 63.3	+ 19.4	+ 1.7	0	−0.16	+ 0.54	− 0.01	− 3.9	−0.6	−0.31	− 16.9	− 3.4	− 1.6
No. 1 to No. 1	5	+ 1.8	− 0.7	− 0.7	+0.25	+0.34	+ 0.73	+ 0.76	− 1.1	0	+0.17	− 0.1	+ 0.6	+ 0.5
No. 5 to No. 5	4	+ 40.1	+ 10.9	+ 13.7	+0.34	+0.18	+ 3.20	+ 1.34	− 4.2	−0.3	−0.02	− 15.6	− 1.1	− 0.2
Pomace to pomace	6	+ 43.5	+ 31.2	− 20.0	+0.33	+0.22	− 2.41	− 0.72	− 9.2	−1.5	−0.50	−106.9	−16.4	− 6.0

(*b*) PERCENTAGE DIFFERENCES

RATIONS	Periods represented	Total dry matter eaten	Total dry matter in experimental feed	Weight of products obtained per 100 lbs. of dry matter: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In experim'l feed: Milk	In experim'l feed: Total solids	In experim'l feed: Fat
		lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lb .	lbs.
No. 2.														
Low to medium	3	+17	....	+11	0	+ 1	+11	+12	− 4	− 5	− 4	....	....	....
Medium to low	5	−13	....	− 9	− 1	− 2	−10	−12	+ 2	+ 1	0	....	....	....
Medium to high	6	+ 9	....	− 1	0	+ 1	− 1	0	− 9	− 9	− 9	....	....	....
High to medium	5	− 9	....	0	0	− 1	0	− 1	+10	+10	+10	....	....	....
No. 3.														
Low to medium	6	+17	....	+ 9	+ 1	+ 1	+11	+12	− 9	− 8	− 7	....	....	....
Medium to low	5	−13	....	−13	0	0	−13	−13	+ 3	+ 3	+ 3	....	....	....
Medium to high	5	+10	....	+ 3	0	− 1	+ 3	+ 3	− 5	− 6	− 6	....	....	....
High to medium	5	− 9	....	− 3	+ 1	+ 2	− 3	− 3	+ 6	+ 6	+ 7	....	....	....
No. 2.														
Low	5	− 1	− 2	+ 1	0	0	0	0	+ 1	+ 1	+ 1	+ 4	+ 3	+ 2
Medium	7	+ 1	0	+ 1	0	0	+ 1	0	0	0	− 1	+ 1	0	0
High	7	+ 1	+ 2	0	0	0	0	0	− 1	− 2	− 1	− 2	− 2	− 1
No. 3.														
Low	5	0	0	0	0	0	0	0	− 2	− 2	0	0	0	0
Medium	8	+ 1	+ 1	+ 1	0	− 1	0	+ 1	0	− 2	− 2	0	0	− 1
High	3	− 2	+ 3	+ 1	0	0	+ 1	+ 2	+ 2	+ 2	+ 3	− 2	− 1	− 2
No. 1 to No. 4	4	−12	−23	−11	+ 1	0	−10	−11	+ 2	+ 2	+ 1	+18	+18	+17
No. 4 to No. 1	3	+12	+25	+15	0	+ 1	+15	+16	+ 3	+ 3	+ 3	− 9	− 7	− 9
No. 4 to No. 5	4	+10	+49	+ 3	+ 1	+ 1	+ 3	+ 4	− 8	− 7	− 5	....	....	....
No. 5 to No. 4	3	− 8	−33	− 3	0	− 1	− 4	− 4	+ 6	+ 4	+ 3	....	....	....
No. 1 to No. 3	2	+ 2	− 6	+ 2	0	0	+ 2	+ 2	0	+ 1	0	+ 8	+ 8	+ 8
No. 3 to No. 1	2	− 2	+ 9	− 5	+ 1	+ 1	− 4	− 3	− 3	− 2	− 1	−13	−12	−11
No. 6 to No. 7	4	0	+ 1	− 1	− 1	− 1	− 1	− 2	0	− 1	− 1	− 2	− 2	− 4
No. 7 to No. 6	3	0	− 1	*3	+ 1	+ 1	−*2	−*2	− 3	− 2	− 2	− 2	− 1	− 1
Silage to pomace	9	− 5	−19	0	+ 1	+ 2	+ 1	+ 3	+ 7	+ 7	+ 9	+25	+26	+27
Pomace to silage	6	+ 6	+27	0	− 1	− 2	− 1	− 2	− 6	− 7	− 8	−26	−27	−28
No. 4 to No. 4	5	+ 3	+ 4	0	0	− 1	0	0	− 1	− 1	− 2	− 1	− 2	− 2
No. 1 to No 1	5	0	0	0	0	+ 2	0	+ 1	0	0	+ 1	0	0	+ 1
No. 5 to No 5	4	+ 2	+ 2	+ 1	+ 1	+ 1	+ 2	+ 2	− 1	− 1	0	− 1	− 1	0
Pomace to pomace	6	+ 2	+ 6	− 2	0	+ 1	− 1	− 1	− 3	− 3	− 3	− 8	− 8	− 8

* Caused by Star Bright's very heavy yield in period III.

VII. RESULTS OF EXPERIMENTAL FEEDING ON DIFFERENT RATIONS.

LOW, MEDIUM AND HIGH GRAIN FEEDING

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs of dry matter in entire ration: Milk	Total solids	Fat	Ratio of percent of fat to percent of solids-not-fat
GRAIN RATION NO. 2. 144 days' feeding on each ration											
	lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	1 :
Low	3126	492	1902	15.61	5.89	290.82	107.30	63.4	9.5	3.45	1.65
Medium	3614	983	2103	15.66	5.96	324.22	121.10	61.7	9.3	3.41	1.63
Medium ± low	+488	+491	+201	+0.05	+0.07	+33.40	+13.80	− 1.7	− 0.2	−0.04	−0.02
Percentage differences	+ 16	+100	+ 11	0	+ 1	+ 11	+ 13	− 3	− 2	− 1	− 1
GRAIN RATION NO. 2. 198 days' feeding on each ration											
Medium	4761	1211	3390	14.83	5.22	500.40	174.89	71.3	10.5	3.67	1.84
High	5230	1815	3372	14.86	5.27	498.19	175.04	64.7	9.5	3.35	1.82
High ± medium	+469	+604	− 18	+0.03	+0.05	− 2.21	+ 0.15	− 6.6	− 1.0	−0.32	−0.02
Percentage differences	+ 10	+ 50	− 1	0	+ 1	0	0	− 9	− 10	− 9	− 1
GRAIN RATION NO. 3. 198 days' feeding on each ration											
Low	4191	688	3259	14.14	4.73	451.66	151.77	76.2	10.9	3.65	1.99
Medium	4881	1349	3545	14.17	4.77	497.36	171.65	71.5	10.2	3.46	1.97
Medium ± low	+690	+661	+286	+0.03	+0.04	+45.70	+19.88	− 4.7	− 0.7	−0.19	−0.02
Percentage differences	+ 16	+ 96	+ 9	0	+ 1	+ 10	+ 13	− 6	− 6	− 5	− 1
GRAIN RATION NO. 3. 180 days' feeding on each ration											
Medium	4665	1288	2909	15.08	5.50	425.63	151.01	61.7	9.1	3.25	1.74
High	5123	1876	3004	14.99	5.43	439.41	155.67	58.7	8.6	3.05	1.76
High ± medium	+458	+588	+ 95	−0.09	−0.07	+13.78	+ 4.66	− 3.0	− 0.5	−0.20	+0.02
Percentage differences	+ 10	+ 46	+ 3	− 1	− 1	+ 3	+ 3	− 5	− 6	− 6	+ 1

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In experimental feed: Milk	In experimental feed: Total solids	In experimental feed: Fat	Ratio of percent of fat to percent of solids-not-fat
LOW GRAIN FEEDING. RATION NO. 2. 90 days' feeding each way														
	lbs.	lbs.	lbs.	%	%	lbs.	lbs	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	1 :
Low (1)	2459	317	1426	16.05	6.01	224.82	82.88	62.0	9.5	3.43	450.7	71.1	26.2	1.67
Low (2)	2371	313	1411	16.11	5.99	222.57	81.30	63.3	9.8	3.49	458.2	71.7	26.0	1.69
Low (2) ± low (1)	− 88	− 4	−15	+0.06	−0.02	−2.25	−1.58	+1.3	+0.3	+0.06	+ 7.5	+ 0.6	− 0.2	+ 0.02
Percentage differences	− 4	− 1	− 1	0	0	− 1	− 2	+ 2	+ 3	+ 2	+ 2	+ 1	− 1	+ 1
MEDIUM GRAIN FEEDING. RATION NO. 2. 126 days' feeding each way														
Medium (1)	3044	895	3139	13.96	4.59	438.22	143.79	103.1	14.4	4.72	351.0	49.0	16.1	20.9
Medium (2)	3194	888	3170	13.93	4.58	441.26	144.51	99.4	13.9	4.53	357.5	49.8	16.3	20.4
Medium (2) ± medium (1)	+150	− 7	+31	−0.03	−0.01	+3.04	+0.72	−3.7	−0.5	−0.19	+ 6.5	+ 0.8	+ 0.2	0
Percentage differences	+ 5	− 1	+ 1	0	0	+ 1	+ 1	− 4	− 3	− 4	+ 2	+ 2	+ 1	0
HIGH GRAIN FEEDING. RATION NO. 2. 126 days' feeding each way														
High (1)	3345	1178	3007	15.04	5.34	449.78	158.52	90.1	13.5	4.74	255.3	38.3	13.5	18.2
High (2)	3386	1213	3037	14.89	5.23	449.69	156.99	89.5	13.3	4.64	249.9	37.1	13.0	18.5
High (2) ± high (1)	+ 41	+35	+30	−0.15	−0.11	−0.09	−1.53	−0.6	−0.2	−0.10	− 5.4	− 1.2	− 0.5	+ 0.03
Percentage differences	+ 1	+ 3	+ 1	− 1	− 2	0	− 1	− 1	− 2	− 2	− 2	− 3	− 4	+ 2
LOW GRAIN FEEDING. RATION NO. 3. 90 days' feeding each way														
Low (1)	1762	320	1545	14.41	4.84	221.75	74.55	88.6	12.8	4.30	481.9	69.2	23.3	2.00
Low (2)	1866	321	1557	14.45	4.90	224.49	75.96	85.3	12.3	4.18	484.9	69.9	23.7	1.95
Low (2) ± low (1)	+104	+ 1	+12	+0.04	+0.06	+2.74	+1.41	−3.3	−0.5	−0.12	+ 3.0	+ 0.7	+ 0.4	− 0.05
Percentage differences	+ 6	0	+ 1	0	+ 1	+ 1	+ 2	− 4	− 4	− 3	+ 1	+ 1	+ 2	− 3

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In experimental feed: Milk	In experimental feed: Total solids	In experimental feed: Fat	Ratio of per cent of fat to per-cent of solids-not-fat
	lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	1 :
MEDIUM GRAIN FEEDING. RATION NO. 2. 144 days' feeding each way														
Medium (1)	3501	987	2472	15.20	5.38	371.24	130.12	70.6	10.6	3.74	249.2	37.6	13.3	1.83
Medium (2)	3500	987	2509	15.20	5.37	375.24	131.00	70.9	10.6	3.72	251.8	37.9	13.3	1.83
Medium (2) ± medium (1)	−1	0	+37	0	−0.01	+4.00	+0.88	+0.3	0	−0.02	+2.6	+0.3	0	0
Percentage differences	0	0	+2	0	0	+ 1	+ 1	0	0	− 1	+ 1	+ 1	0	0
HIGH GRAIN FEEDING. RATION NO. 3. 54 days' feeding each way														
High (1)	1477	538	1340	15.20	5.41	196.82	68.08	91.3	13.4	4.63	251.2	36.9	12.7	1.81
High (2)	1461	543	1349	15.28	5.52	200.03	70.68	91.8	13.6	4.82	252 7	37.7	13.2	1.77
High (2) ± high (1)	− 16	+25	+ 9	+0.08	+0.11	+3.21	+2.60	+0.5	+0.2	+0 19	+ 1.5	+ 0.8	+ 0.5	−0.04
Percentage differences	− 1	+ 1	+ 1	+ 1	+ 2	+ 2	+ 4	+ 1	+ 1	+ 4	+ 1	+ 2	+ 4	− 2
MALT SPROUTS. I VS. IV. 126 days' feeding on each ration														
I	3197	894	2099	14.28	4.89	300.32	103.24	65.4	9.4	3.22	234.6	33.6	11.5	1.92
IV	2835	703	1851	14.35	4.87	265.87	90.44	65.3	9.4	3.19	268.6	38.6	13.1	1.95
IV ± I	−362	−191	−248	+0.07	−0.02	−34.45	−12.80	−0.1	0	−0.03	+34.0	+ 5.0	+ 1.6	+0.03
Percentage differences	− 11	−21	−12	0	0	− 11	− 12	0	0	− 1	+ 15	+ 15	+ 14	+ 2

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter: In entire ration: Milk	In entire ration: Total solids	In entire ration: Fat	In experimental feed: Milk	In experimental feed: Total solids	In experimental feed: Fat	Ratio of percent of fat to percent of solids-not-fat
MALT SPROUTS. V VS. IV. 126 days' feeding on each ration														
	lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	1 :
V	2908	799	1797	14.95	5.16	267.41	91.42	61.8	9.2	3.15				1.90
IV	2662	539	1744	14.86	5.10	257.96	87.84	66.3	9.7	3.29				1.91
IV ± V	−246	−260	−53	−0.09	−0.06	−9.45	−3.58	+4.5	+0.5	+0.14				+ 0.01
Percentage differences	− 8	−33	− 3	− 1	− 1	− 4	− 4	+ 7	+ 5	+ 4				+ 1
DRIED BREWERS' GRAINS. I VS. III. 72 days' feeding on each ration														
I	1759	511	874	14.82	5.19	129.47	45 26	49.7	7 4	2 57	171.1	25.4	8 9	1.86
III	1797	476	903	14.78	5.16	133.36	46.41	50.3	7.5	2.58	190.5	28.1	9.8	1.86
III ± I	+ 38	−35	+29	−0.04	−0.03	+3.89	+1.15	+0.6	+0.1	+0.01	+19.4	+ 2.7	+ 0.9	0
Percentage differences	+ 2	− 7	+ 3	0	− 1	+ 3	+ 3	+ 1	+ 1	0	+ 11	+ 11	+ 10	0
KING GLUTEN MEAL. VI VS. VII. 126 days' feeding on each ration														
VI	3059	889	3202	14.51	4.93	461.04	155.80	104.2	15.0	5.08	360.6	51.9	17.6	1.94
VII	3056	895	3226	14.42	4.87	461.24	154.70	105.8	15.1	5.07	360.2	51.5	17.3	1.96
VII ± VI	− 3	+ 6	+24	−0.09	−0.06	+0.20	−1.10	+1.6	+0.1	−0.01	− 0.4	− 0.4	− 0.3	+ 0.02
Percentage differences	0	+ 1	+ 1	− 1	− 1	0	− 1	+ 2	+ 1	0	0	− 1	− 2	+ 1
SILAGE VS. APPLE POMACE. 270 days' feeding on each ration														
Silage	6534	2093	4080	14.57	4.99	595.44	203.59	63.0	9.2	3.16	197.9	28.9	9 9	1.92
Apple pomace	6171	1677	4086	14.68	5.11	601.35	209.03	67.2	10.0	3.42	255.6	37.7	13.1	1.87
Apple pomace ± silage	−363	−416	+ 6	+0.11	+0.12	+5.91	+5.44	+4.2	+0.8	+0.28	+57.7	+ 8.8	+ 3.2	− 0.05
Percentage differences	− 6	−20	0	+ 1	+ 2	+ 1	+ 3	+ 7	+ 9	+ 9	+ 29	+ 30	+ 32	− 3

RATIONS	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter: In entire ration: Total solids	In entire ration: Fat	In experimental feed: Milk	In experimental feed: Total solids	In experimental feed: Fat	Ratio of percent of fat to percent of solids-not-fat
MALT SPROUTS AND BRAN (No. 4). 90 days' feeding each way											
	lbs.	lbs.	lbs.	%	%	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	lbs.	1:
IV (1)	2162	540	1284	15.46	5.51	196.16	69.81	59.8	9.1	3.24	243.1	37.0	13 2	1.81
IV (2)	1996	504	1197	15.42	5.51	182.48	64.90	59.7	9.1	3.24	239.1	36.5	13.0	1.80
(2) ± (1)	−166	−36	−87	−0.04	0	−13.68	−4.91	−0.1	0	0	− 4.0	− 0.5	− 0.2	− 0.01
Percentage differences	− 8	− 7	− 7	0	0	− 7	− 7	0	0	0	− 2	− 1	− 2	− 1
COTTONSEED-LINSEED BRAN (No. 1). 90 days' feeding on each ration											
I (1)	2190	606	1513	14.67	5.00	222.10	75.78	69.4	10.2	3.45	252.6	36.9	12.5	1.93
I (2)	2087	606	1482	14.69	4.99	217.62	73.94	71.3	10.4	3.53	247.6	36.1	12.2	1.94
(2) ± (1)	−103	0	−31	+0.02	−0.01	−4.48	−1.84	+1.9	+0.2	+0.08	− 5.0	− 0.8	− 0.3	+ 0.01
Percentage differences	− 5	0	− 2	0	0	− 2	− 2	+ 3	+ 2	+ 2	− 2	− 2	− 2	+ 1
GROUND OATS AND BRAN (No. 5). 72 days' feeding each way											
V (1)	1718	493	1372	14.02	4.56	192.66	62.95	79.8	11.2	3.66	278.6	39.1	12.8	2.07
V (2)	1790	506	1375	14.05	4.59	193.38	63.29	77.1	10.9	3.55	271.8	38.2	12.6	2.06
V (2) ± V (1)	+ 72	+13	+ 3	+0.03	+0.03	+0.72	+0.34	−2.7	−0.3	−0.11	− 6.8	− 0.9	− 0.2	− 0.01
Percentage differences	+ 4	+ 3	0	0	+ 1	0	+ 1	− 3	− 3	− 3	− 2	− 2	− 2	0
APPLE POMACE. 108 days' feeding on each ration											
Apple pom. (1)	2405	574	1274	15.94	6.06	197.89	73.54	51.0	8.5	3.20	220.9	34.7	13.1	1.63
Apple pom. (2)	2369	596	1282	15.88	6.03	198.28	73 62	53.2	8.4	3.16	213.6	33.3	12.5	1.63
(2) ± (1)	− 36	+22	+ 8	−0.06	−0.03	+0.39	+0.08	−0.6	−0.1	−0.04	− 7.3	− 1.4	− 0.6	0
Percentage differences	− 1	+ 4	+ 1	0	0	0	0	− 1	− 1	− 1	− 3	− 4	− 5	0

NOTE EXPLANATORY OF VI "DIFFERENCE TABLES," (PAGES xxix-xxx), AND VII "RESULTS OF EXPERIMENTAL FEEDING," (PAGES xxxi-xxxv)

Although "difference tables" have been printed in the last six reports accompanied by full explanations of their meaning, they are so condensed from the data of table V that explanatory notes seem still in order.

When a cow eats a certain ration during a feeding period, another during a second period, returning to the first ration for a third period, all three being of equal lengths, and, as far as may be, all other things being equal, it is fair to assume, and in the discussion of feeding experiments is usually assumed, that the average of the results obtained during the first and third periods on the ration then fed is what would have been secured during the second period had the feeding continued on one ration. A comparison of this average with the results actually obtained with another ration serves to show the relative value of the different fodders and feeds. The *difference between these calculated averages and the actual results* form the "differences" which measure the relative values of the two rations.

The first comparison of the record of the cow Goldenrod (page xviii) is given in full to show more clearly just what is meant by the figures in the "difference tables."

Record of GOLDENROD for the experimental portions of periods I, II and III	Total dry matter eaten	Dry matter eaten in experimental feed	Milk	Total solids	Fat	Total solids	Fat	Weight of products obtained per 100 lbs. of dry matter: In entire ration — Milk	Total solids	Fat
Average of actual records for periods I and III (medium rations)	lbs. 518.2	lbs. 127.5	lbs. 234.1	% 17.46	% 7.28	lbs. 40.80	lbs. 16.98	lbs. 45.2	lbs. 7.9	lbs. 3.28
Actual record for period II (low ration)	429.6	66.3	206.8	17.85	7.50	36.91	15.51	48.1	8.6	3.61
Record made upon low ration ± the average of those made on medium ration	−88.6	−64.5	−27.3	+0.39	+0.22	−3.89	−1.47	+ 2.9	+0.7	+0.33

The first horizontal line of figures shows the average of the records of dry matter eaten, and of milk, solids, and fat given, etc., obtained in the experimental portions of the first and third feeding periods, while the cow was eating the medium grain ration, (page xviii). The second horizontal line of figures shows the actual records of dry matter, milk, etc., obtained during the experimental portion of the second period when she ate the low grain ration, (page xviii). The third horizontal line shows the amounts, greater or less as the case may be, of dry matter eaten, milk given, etc., when the low ration was fed as compared with the average of the records on the medium ration. These differences furnish a measure of the relative value of the two rations, it being assumed, as stated above, that the averages correctly indicate the consumption and production which would have occurred during the intervening period had the ration remained unchanged.

The figures in the third horizontal line in the above table, together with four other sets similarly obtained by comparing Goldenrod's periods III and V (averaged) with IV, Lorna Doone's IV and VI (averaged) with V, and Viola's II and IV (averaged) with III, and IV and VI (averaged) with V, all added, each column by itself gave the second horizontal line in table (*a*) "totals of differences." (page xxix) beginning 5—273.4—301.3—129.5, etc. The figures in table (*b*) "percentage differences"—which are the final results and measures of the relative worth of the various rations—are obtained by dividing the "total differences" by the total actual consumption (of dry matter) or production (of milk, solids, fat and the same proportionate to 100 pounds of dry matter eaten). Thus for example, the calculated amounts of dry matter eaten when the medium grain ration was fed to the cows mentioned above in the averages of the experimental portions of the periods given in couplets—for example, Goldenrod's I and III, and III and V,—was 2172.6 pounds. This is 273.4 pounds less than the amounts actually eaten when the low ration was fed (1899.2 pounds). Division furnishes the percentage differences, 273.4 divided by 2172.6, multiplied by 100 equals 13. The "percentage difference" is —13, or in other words, the cows when fed on the low ration during the intermediate periods ate 13 percent less dry matter than presumedly they would have eaten had they continued on the medium ration at precisely the same time they did eat the lower one. This figure (—13) leads the second horizontal line in table (*b*) "percentage differences," (page xxx). Similar comparisons with the remaining items show the percent of excess or deficit of consumption or product resulting from the use of the lower ration as compared with the medium one.

The outcome of certain of the experiments is also shown in a somewhat different manner in table VII "Results of Experimental Feeding on Different Rations," wherein the total products for each period and for each calculated period are added. Thus, for example, in the case of the cows Goldenrod, Lorna Doone and Viola, fed respectively six, three and five periods, including 14 eighteen-day experimental portions, a comparison of 144 days feeding for one cow on each ration may be made and neither side of the comparison suffer from the effects of advancing lactation, this being equalized. The use of the data found in table V "Production Records," with the cows in question for the experimental portion of the periods stated below will give the equivalent of 144 days feeding on a medium ration.

Goldenrod; periods III and V	36 days feeding
Viola; period IV	18 days feeding
Goldenrod; the average of records of periods I and III and of III and V on the medium ration; equivalent respectively to what might reasonably have been expected to have been the results in periods II and IV had the feeding on the medium ration been continued	36 days feeding
Viola; the average of records of periods II and IV and IV and VI on the medium ration; equivalent, etc., to periods III and V on the medium ration	36 days feeding
Lorna Doone; the average of records of periods IV and VI on the medium ration; equivalent, etc., to period V on the medium ration	18 days feeding
Equivalent to 144 days feeding on medium ration	

Using the data on the low ration the following combination gives 144 days feeding:

Goldenrod; periods II and IV	36 days feeding
Viola; periods III and V	36 days feeding
Lorna Doone; period V	18 days feeding
Goldenrod; the average of records of periods II and IV and of IV and VI on the low ration; equivalent, etc., to periods III and V on the low ration	36 days feeding
Viola; the average of records of periods III and V on the low ration; equivalent, etc., to period IV on the low ration	18 days feeding
Equivalent to 144 days feeding on low ration	

This permits the calculation of the consumption and production of each cow on each ration for the selfsame days of the experimental portion of the periods other than the first and last used with each cow, thus affording an excellent and, usually, accurate measure of the relative worth of the two rations. The result of this comparison is given at the beginning of table VII (page xxxi) inthe first set, the low ration figures beginning 3126, 492, 1902, and the medium ration data 3614, 983, 2103. The average percentages of total solids and fat are obtained by addition and not by cross division. This gives to each cow the same influence upon the final results instead of giving greatest preponderance to those yielding most largely of milk, solids and fat, and less to those giving smaller amounts.

It should be remarked, however, that as a matter of fact exact equality cannot always be obtained by the method of calculation last referred to. Wher a cow maintains her milk flow fairly well, little or no trouble is encountered When, however, considerable shrinkage occurs, the side of the comparison which includes the record of the first period has, as a rule, the advantage. In other words the figures derived from the means of the results of periods I and III, III and V, V and VII, and from the actual records of periods III and V, may have an advantage over those obtained from the means of the results of periods II and IV, IV and VI, and from the actual records of periods II, IV and VI. This is due to the fact that the records of the first period, in which, often, the heaviest milk flow is given, helps on the one side of the comparison and not on the other. To be sure this side has also to carry the records of the last period, wherein, frequently, the smallest flow is given. Sometimes, but not always, these two tend to counterbalance. If shrinkage is large in the last period it is usually but not always thrown out of the experiment. The first period is seldom thus excluded however; hence occasionally this condition is met.

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